MINERALS YEARBOOK

1961

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UNITED STATES DEPARTMENT OF THE INTERIOR

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FOREWORD

MINERALS YEARBOOK, 1961, published in three volumes, provides a record of performance of the Nation's mineral industries during the year, with enough background information to interpret the year's developments.

The three-volume issues of the Yearbook follow this pattern:

Volume I includes chapters on metal and nonmetal mineral commodities except mineral fuels. In addition, it contains a chapter reviewing these mineral industries, a statistical summary, and chapters on mining and metallurgical technology, employment and injuries, and technologic trends. The chapter on "High-Purity Silicon," new in the 1960 volume, has been renamed "Silicon." This chapter has been enlarged to incorporate data on metallurgical silicon and its alloys with iron. Also, an additional chapter in the 1961 volume I compares Bureau of Mines mineral-commodity production data for 1958 with those presented in the 1958 Census of Mineral Industry reports published by the United States Department of Commerce.

Volume II includes chapters on each mineral fuel, an employment and injuries presentation, and a mineral-fuels review chapter that summarizes development in the fuel industries.

Volume III contains chapters covering each of the 50 States, plus chapters on island possessions in the Pacific Ocean and the Commonwealth of Puerto Rico and island possessions in the Caribbean Sea, including the Canal Zone. Volume III also has a statistical summary chapter, identical with that in volume I, and a chapter on employment and injuries.

Figures in the Minerals Yearbook are based largely upon information supplied by mineral producers, processors, and users, and acknowledgment is made of this indispensable cooperation given by industry. Information obtained from individuals through confidential surveys has been grouped to provide statistical aggregates. Data on individual producers are presented only if available from published or other nonconfidential sources, or when permission of the individuals concerned has been granted.

MARLING J. ANKENY, *Director.*

18 Dec. 1962

ACKNOWLEDGMENTS

In preparing this volume of the MINERALS YEARBOOK, the Bureau of Mines was assisted in collecting statistical data and mineral-industry information by State agencies, through cooperative agreements. Many State chapters were reviewed by staff members of these agencies, and in some instances the staff members collaborated in preparing the chapters and are shown as coauthors. For this assistance acknowledgment is made to the following cooperating organizations:

Alabama: Geological Survey of Alabama.
Alaska: Department of Natural Resources.
Arizona: Arizona Bureau of Mines.
Arkansas: Geological and Conservation Commission; Arkansas Oil and Gas Commission; Department of Revenue.
California: Division of Mines and Geology.
Delaware: Delaware Geological Survey.
Florida: Florida Geological Survey.
Georgia: Geological Survey of Georgia.
Hawaii: Department of Land and Natural Resources.
Idaho: Bureau of Mines and Geology.
Illinois: State Geological Survey Division.
Indiana. Geological Survey, Department of Conservation.
Iowa: Iowa Geological Survey.
Kansas: Conservation Division, State Corporation Commission and State Geological Survey of Kansas.
Kentucky: Kentucky Geological Survey.
Louisiana: Louisiana Geological Survey and Louisiana Department of Conservation.
Maine: Geological Survey of Maine.
Maryland: Department of Geology, Mines, and Water Resources.
Michigan: Geological Survey Division, Department of Conservation.
Mississippi: Mississippi Geological Survey, Mississippi State Oil and Gas Board, and Oil and Gas Severance Tax Division, Mississippi State Tax Commission.
Missouri: Division of Geological Survey and Water Resources, Department of Business Administration.
Montana: Montana Bureau of Mines and Geology.
Nevada: Nevada Bureau of Mines.
New Hampshire: New Hampshire State Planning and Development Commission.
New Jersey: Bureau of Geology and Topography.
New York: New York State Science Service.
North Carolina: Geological Survey of North Carolina.
North Dakota: North Dakota Geological Survey.
Oklahoma: Oklahoma Geological Survey and Oil and Gas Conservation Department; Oklahoma Corporation Commission, Gross Production Division; Oklahoma Tax Commission.
Oregon: State Department of Geology and Mineral Industries.
Pennsylvania: Bureau of Topographic and Geological Survey.
Puerto Rico: Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.
South Carolina: Geological Survey of South Carolina.
South Dakota: State Geological Survey.
Tennessee: Department of Conservation and Commerce.

Texas: Bureau of Economic Geology, The University of Texas; Oil and Gas Division, Railroad Commission of Texas; Oil and Gas Division, State Comptroller of Public Accounts.
Utah: Utah Geological and Mineralogical Survey.
Virginia: Division of Mineral Resources.
Washington: Division of Mines and Geology, Department of Conservation and Development.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological Survey.
Wyoming: The Geological Survey of Wyoming.

Except for the two review chapters, this volume was prepared by the field staffs of the five Divisions of Mineral Resources. Preparation of this volume was supervised and the chapters coordinated with those in volumes I and II by Donald R. Irving, assistant to the chief, Division of Minerals.

Statisticians and researchers in the Division of Mineral Resources who gave substantial assistance to the authors of the chapters were: In Region I, Clara M. Hutcheson and Georgia A. Kerns; in Region II, Betty Tong and Sophie Chibidakis; in Region III, Stella K. Drake, Elsie J. Kellog, Ruth C. Nichols, Mariel L. Andrews, and Virginia R. Welliever; in Region IV, Dorothy Underwood, Lorraine Collier, Betty Siggins, Ada Watson, Betty C. O'Niel, and Pauline Culmer; in Region V, (Pittsburgh) Michael E. Bursic, Victoria M. Dorchak, and Stephanie A. Dzienis, (Knoxville) Martha E. Peeples and Mildred K. Rees, (Minneapolis) Marguerite H. Beahan, Richard J. Bishop, Estelle E. Rand, Don N. West, Wanda J. West, Ella R. Humenansky, and Theodore A. Myren.

The manuscripts upon which this volume is based have been reviewed to insure statistical consistency among the tables, figures, and text, between this volume and volumes I and II and between this volume and those for former years, and reconciled by a staff supervised by Kathleen J. D'Amico, who was assisted by Julia Muscal, Helen L. Gealy, Helen E. Tice, Mary E. Daugherty, Nellie W. Fahrney, and Joseph Spann.

Minerals Yearbook compilations are based largely on data provided by the mineral industries. Acknowledgment is made of the willing contribution both by companies and individuals of these essential data.

CHARLES W. MERRILL,
Chief, Division of Minerals.

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Statistical Summary of Mineral Production

By Kathleen J. D'Amico [1]

❖

THIS SUMMARY is shown in Minerals Yearbook volumes I and III of this series on mineral production in the United States, its island possessions, the Canal Zone, and the Commonwealth of Puerto Rico, and on the principal minerals imported into and exported from the United States. The several commodity and area chapters contain further details on production. A summary table comparing world and U.S. mineral production also is included.

Mineral production may be measured at any of several stages of extraction and processing. The stage of measurement used in the chapter is normally what is termed "mine output." It usually refers to minerals in the form in which they are first extracted from the ground, but customarily includes for some minerals the product of auxiliary processing operations at or near mines.

TABLE 1.—Value of mineral production in the United States,[1] 1925–61, by mineral groups [2]

(Millions)

Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total
1925	$2,910	$1,187	$715	$4,812
1926	3,371	1,219	721	5,311
1927	2,875	1,201	622	4,698
1928	2,666	1,163	655	4,484
1929	2,940	1,166	802	4,908
1930	2,500	973	507	3,980
1931	1,620	671	287	2,578
1932	1,460	412	128	2,000
1933	1,413	432	205	2,050
1934	1,947	520	277	2,744
1935	2,013	564	365	2,942
1936	2,405	685	516	3,606
1937	2,798	711	756	4,265
1938	2,436	622	460	3,518
1939	2,423	754	631	3,808
1940	2,662	784	752	4,198
1941	3,228	989	890	5,107
1942	3,568	1,056	999	5,623
1943	4,028	916	987	5,931
1944	$4,574	$836	$900	$6,310
1945	4,569	888	774	6,231
1946	5,090	1,243	729	7,062
1947	7,188	1,338	1,084	9,610
1948	9,502	1,552	1,219	12,273
1949	7,920	1,559	1,101	10,580
1950	8,689	1,822	1,351	11,862
1951	9,779	2,079	1,671	13,529
1952	9,616	2,163	1,617	13,396
1953	10,257	2,350	1,811	14,418
1954	9,919	[3] 2,630	1,518	14,067
1955	10,780	[3] 2,957	2,055	15,792
1956	11,741	[3] 3,266	2,358	17,365
1957	12,709	[3] 3,267	2,137	18,113
1958	11,589	[3] 3,346	1,594	16,529
1959	11,950	[3] 3,721	1,570	17,241
1960	[4] 12,142	[3] 3,732	[4] 2,022	[4] 17,896
1961	12,358	[3] 3,846	1,927	18,131

[1] Excludes Alaska and Hawaii, 1925–53.

[2] Data for 1925–46 are not strictly comparable with those for subsequent years, since for earlier years value of heavy clay products has not been replaced by value of raw clays used for such products.

[3] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and/or lime.

[4] Revised figure.

---

[1] Statistical officer.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. The quantities of gold, silver, copper, lead, zinc, and tin are recorded on a mine basis (as the recoverable content of ore sold or treated). The values assigned to these quantities, however, are based on the average selling price of refined metal, not the mine value. Mercury is measured as recovered metal and valued at the average New York price for metal.

Data for clays and stone, 1954–61, included output used in making cement and lime. Mineral-production totals have been adjusted to eliminate duplicating these values.

The weight or volume units shown are those customary in the particular industries producing the respective commodities. No adjustment has been made in dollar values for changes in purchasing power of the dollar.

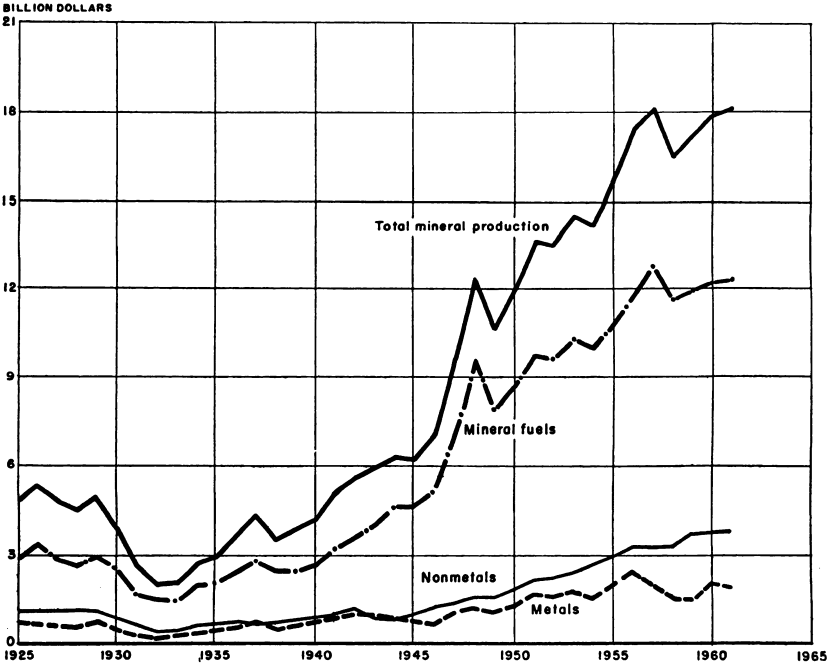

FIGURE 1. Value of mineral production in the United States, 1925–61.

TABLE 2.—Mineral production [1] in the United States

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Mineral fuels:								
Asphalt and related bitumens (native):								
Bituminous limestone and sandstone……short tons	1,326,493	$3,343	1,518,765	$3,868	1,242,874	$3,070	1,558,792	$12,818
Gilsonite……do	317,280	4,864	379,362	9,385	383,037	10,020		
Carbon dioxide, natural (estimate)……thousand cubic feet	722,615	102	485,179	71	521,169	99	545,354	82
Coal:								
Bituminous and lignite [2]……thousand short tons	410,446	1,996,281	412,028	1,965,607	415,512	1,950,425	402,977	1,844,563
Pennsylvania anthracite……do	21,171	187,898	20,649	172,320	18,817	147,116	17,446	140,338
Helium……thousand cubic feet	352,134	5,741	375,408	6,144	475,179	7,768	551,785	10,263
Natural gas……million cubic feet	11,030,298	1,317,492	12,046,115	1,556,800	12,771,038	1,789,970	13,254,025	1,996,241
Natural gas liquids:								
Natural gasoline and cycle products……thousand gallons	5,596,458	393,139	5,597,102	408,694	5,842,507	416,819	6,105,463	412,019
LP gases……do	6,783,000	296,571	7,874,706	349,802	8,444,074	391,566	9,085,465	370,186
Peat……short tons	327,813	3,446	419,460	4,372	470,889	5,138	524,695	4,991
Petroleum (crude)……thousand 42-gallon barrels	2,449,016	7,380,065	2,574,590	7,473,336	2,574,933	7,420,181	[3] 2,621,758	[3] 7,566,945
Total mineral fuels	----------	11,589,000	----------	11,950,000	----------	12,142,000	----------	12,358,000
Nonmetals (except fuels):								
Abrasive stone [4]……short tons	4,023	305	3,672	315	2,539	240	2,495	238
Aplite……long tons	(5)	(5)	(5)	(5)	(5)	(5)	97,465	651
Asbestos……short tons	43,979	5,127	45,459	4,391	45,223	4,231	52,814	4,347
Barite……do	605,402	7,508	901,815	10,301	[6] 714,276	[6] 8,574	798,785	9,315
Boron minerals……do	528,209	38,310	619,946	46,150	640,591	47,550	602,613	46,936
Bromine……thousand pounds	176,397	46,689	195,483	51,508	175,010	44,637	180,798	44,517
Cement:								
Portland……thousand 376-pound barrels	317,263	1,038,672	346,675	1,144,867	321,646	1,089,134	314,821	1,048,832
Masonry……thousand 280-pound barrels							19,275	55,737
Natural and slag……thousand 376-pound barrels							269	968
Clays……thousand short tons	43,750	143,487	49,383	159,659	[6] 49,069	[6] 162,411	47.389	156,829
Emery……short tons	7,687	126	8.555	150	8,169	142	6,180	106
Feldspar……long tons	469,738	4,278	548,390	5,372	502,380	4,779	496,808	5,120
Fluorspar……short tons	319,513	15,071	185,091	8,680	229,782	10,391	205,083	9,275
Garnet (abrasive)……do	12,303	869	14,568	1,211	10,522	986	12,057	1,036
Gem stones (estimate)	(7)	1,006	(7)	1,184	(7)	1,188	(7)	1,309
Gypsum……thousand short tons	9,600	32,495	10,900	39,231	9,825	35,690	9,500	34,950
Lime……do	9,203	120,921	12,498	163,890	[6] 12,935	[6] 172,731	15,192	210.127
Magnesite……short tons	492,982	2,409	594,307	2,401	498,528	2,051	603,656	3,129
Magnesium compounds from sea water and brine (except for metals)……short tons, MgO equivalent	207,053	16,419	276,309	21,636	293,454	21,903	356,384	25,545

See footnotes at end of table.

TABLE 2.—Mineral production [1] in the United States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetal (except fuels)—Continued								
Mica:								
Scrap...short tons	93,347	$2,065	101,541	$2,665	[6] 97,912	[6] $2,698	99,044	$2,417
Sheet...pounds	661,344	2,845	706,395	3,419	[6] 571,108	[6] 3,183	480,494	3,308
Perlite...short tons	291,994	2,463	324,669	2,737	312,153	2,665	310,338	2,664
Phosphate rock...thousand long tons	14,879	93,693	15,869	98,758	17,516	117,041	18,559	130,535
Potassium salts...thousand short tons, K_2O equivalent	2,147	75,000	2,383	80,393	2,638	[6] 89,676	2,732	104,464
Pumice...thousand short tons	1,973	5,287	2,276	5,863	2,210	5,569	2,463	6,799
Pyrites...thousand long tons	974	7,987	1,057	8,148	1,016	7,936	988	7,418
Salt...thousand short tons	21,911	141,486	25,160	155,839	25,479	161,140	25,707	160,223
Sand and gravel...do	684,498	652,789	730,205	728,712	[6] 709,792	[6] 720,432	751,784	751,301
Sodium carbonate (natural)...short tons	628,619	17,032	735,261	19,078	808,624	20,865	805,828	20,444
Sodium sulfate (natural)...do	347,445	6,716	402,743	7,689	449,631	8,706	465,814	9,296
Stone [8]...thousand short tons	535,923	826,685	584,163	911,982	[6] 616,784	[6] 952,555	615,388	950,560
Sulfur:								
Frasch process mines...thousand long tons	4,644	109,272	5,222	121,777	5,003	115,494	5,082	117,884
Other mines...long tons	153,574	1,505	151,932	1,418	181,422	1,732	177,549	1,694
Talc, soapstone, and pyrophyllite...short tons	718,165	4,718	791,558	5,641	734,473	5,378	761,318	5,267
Tripoli...do	47,044	183	52,968	219	57,713	247	54,641	225
Vermiculite...thousand short tons	191	2,728	207	3,082	199	3,108	206	3,350
Value of items that cannot be disclosed: Brucite (1958-59), calcium-magnesium chloride, diatomite, epsom salts from epsomite (1961), graphite, iodine, kyanite, lithium minerals, greensand marl, nitrogen compounds (1958), olivine, staurolite (1958, 1960-61), strontium minerals (1958-59), wollastonite, and values indicated by footnote 5	----------	[8] 39,642	----------	[8] 42,322	----------	[6] 42,664	----------	44,743
Total nonmetals [9]	----------	3,346,000	----------	3,721,000	----------	3,732,000	----------	3,846,000
Metals:								
Antimony ore and concentrate...short tons, antimony content	716	(10)	688	(10)	635	(10)	689	(10)
Bauxite...long tons, dried equivalent	1,310,685	12,815	1,700,235	17,725	1,997,827	21,107	1,228,032	13,937
Beryllium concentrate...short tons, gross weight	505	243	425	179	509	162	[11] 1,122	(10)
Chromite...do	143,795	6,187	[12] 105,000	[12] 3,765	[12] 107,000	[12] 3,813	[12] 82,000	[12] 2,939
Cobalt (content of concentrate)...thousand pounds	4,832	(10)	2,944	(10)	(10)	(10)	(10)	(10)
Columbium-tantalum concentrate [13]...pounds	428,347	(10)	189,263	(10)	----------	----------	----------	----------
Copper (recoverable content of ores, etc.)...short tons	979,329	515,127	824,846	506,455	1,080,169	693,468	1,165,155	699,093
Gold (recoverable content of ores, etc.)...troy ounces	1,739,249	60,874	1,602,931	56,103	1,666,772	58,336	1,548,270	54,189
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	66,288	569,154	59,164	514,067	[6] 82,963	[6] 724,131	72,378	650,501
Lead (recoverable content of ores, etc.)...short tons	267,377	62,566	255,586	58,786	246,669	57,722	261,921	53,956

Manganese ore (35 percent or more Mn) short tons, gross weight	327,309	23,637	229,199	17,904	80,021	5,352	46,088	3,264
Manganiferous ore (5 to 35 percent Mn) do	520,601	3,532	470,600	3,153	658,455	4,466	225,004	1,480
Mercury 76-pound flasks	38,067	8,720	31,256	7,110	33,223	7,002	31,662	6,257
Molybdenum (content of concentrate) thousand pounds	42,328	50,371	51,603	64,655	69,941	87,406	66,753	87,925
Nickel (content of ore and concentrate) short tons	13,489	(10)	13,374	(10)	14,079	(10)	13,133	(10)
Rare-earth and thorium concentrates do	2,021	286	1,143	206	(10)	(10)	(10)	(10)
Silver (recoverable content of ores, etc.) thousand troy ounces	34,111	30,872	31,194	28,233	30,766	27,846	34,794	32,166
Tin (content of ore and concentrate) long tons	--------	--------	50	60	10	12	(10)	(10)
Titanium concentrate:								
Ilmenite short tons, gross weight	565,164	11,152	637,263	12,106	[6] 789,237	14,655	782,629	13,320
Rutile do	1,863	210	8,648	877	[6] 9,226	[6] 957	7,664	778
Tungsten ore and concentrate short tons, 60-percent WO_3 basis	3,788	3,991	3,649	4,502	7,325	9,815	8,245	10,565
Uranium ore short tons	5,178,315	116,397	6,934,927	141,349	7,970,211	152,188	8,041,329	148,299
Vanadium (recoverable in ore and concentrate) do	3,030	10,817	3,719	13,278	4,971	17,749	5,343	19,076
Zinc (recoverable content of ores, etc.) do	412,005	84,113	425,303	97,787	435,427	112,365	464,390	106,848
Value of items that cannot be disclosed: Chromite,[12] magnesium chloride for magnesium metal, manganiferous residuum, platinum-group metals (crude), zirconium concentrate, and values indicated by footnote 10	--------	23,245	--------	21,763	--------	23,078	--------	22,582
Total metals	--------	1,594,000	--------	1,570,000	--------	2,022,000	--------	1,927,000
Grand total mineral production	--------	16,529,000	--------	17,241,000	--------	17,896,000	--------	18,131,000

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[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Includes small quantity of anthracite mined in States other than Pennsylvania.

[3] Preliminary figure.

[4] Grindstones, pulpstones, millstones (weight not recorded), grinding pebbles, sharpening stones, and tube-mill liners.

[5] Figure withheld to avoid disclosing individual company confidential data; value included with "Nonmetal items that cannot be disclosed."

[6] Revised figure.

[7] Weight not recorded.

[8] Excludes abrasive stone, bituminous limestone, bituminous sandstone, and ground soapstone, all included elsewhere in table.

[9] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and/or lime.

[10] Figure withheld to avoid disclosing individual company confidential data; value included with "Metal items that cannot be disclosed."

[11] Includes 805 tons of low-grade beryllium ore.

[12] Excludes quantity consumed by American Chrome Co.

[13] Total weight of columbite-tantalite plus $(Cb\text{-}Ta)_2O_5$ content of euxenite.

TABLE 3.—Minerals produced in the United States and principal producing States in 1961

Mineral	Principal producing States, in order of quantity	Other producing States
Antimony	Idaho	
Aplite	Va	
Asbestos	Vt., Calif., Ariz., N.C	Oreg.
Asphalt	Tex., Utah, Ala., Mo	
Barite	Ark., Mo., Nev., Ga	Calif., Idaho, Ky., Mont., N. Mex., N.C., S.C., Tenn., Tex., Utah, Wash.
Bauxite	Ark., Ga., Ala	
Beryllium	Colo., S. Dak., N. Mex., N.H	Ariz., Conn., Maine, N.Y., Wyo.
Boron	Calif	
Bromine	Mich., Tex., Ark., Calif	W. Va.
Calcium-magnesium chloride.	Mich., Calif., W. Va	
Carbon dioxide	N. Mex., Colo., Utah, Calif	Wash.
Cement	Calif., Pa., Tex., Mich	Ala., Ariz., Ark., Colo., Fla., Ga., Hawaii, Idaho, Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Minn., Miss., Mo., Mont., Nebr., N. Mex., N.Y., Ohio. Okla., Oreg., S.C., S. Dak., Tenn., Utah, Va., Wash., W. Va., Wis., Wyo.
Chromite	Mont	
Clays	Ohio, Tex., Ga., Calif	All other States except Alaska, Hawaii, R.I.
Coal	W. Va., Pa., Ky., Ill	Ala., Alaska, Ark., Colo., Ga., Ind., Iowa, Kans., Md., Mo., Mont., N. Mex., N. Dak., Ohio, Okla., S. Dak., Tenn., Utah, Va., Wash., Wyo.
Cobalt	Pa., Mo	
Copper	Ariz., Utah, Mont., N. Mex	Alaska, Calif., Colo., Idaho, Mich., Mo., Nev., N.C., Oreg., Pa., Tenn., Wash., Wyo.
Diatomite	Calif., Nev., Wash., Oreg	Ariz.
Emery	N.Y	
Feldspar	N.C., Calif., Conn., Ga	Ariz., Colo., Maine, N.H., S.C., S. Dak., Tex., Va.
Fluorspar	Ill., Ky., Nev., Colo	Calif., Mont., Utah.
Garnet, abrasive	N.Y., Idaho	
Gold	S. Dak., Utah, Ariz., Wash	Alaska, Calif., Colo., Idaho, Mont., Nev., N. Mex., N.C., Oreg., Pa., Tenn., Wyo.
Graphite	Tex., Pa	
Gypsum	Calif., Mich., Iowa, Tex	Ariz., Ark., Colo., Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah Va., Wash., Wyo.
Helium	Okla., Tex., N. Mex., Kans	
Iodine	Calif., Mich	
Iron ore	Minn., Mich., Ala., Utah	Ariz., Calif., Colo., Ga., Idaho, Mo., Mont., Nev., N.J. N. Mex., N.Y., N.C., Oreg., Pa., S. Dak., Tenn., Tex., Va., Wis., Wyo.
Kyanite	Va., S.C	
Lead	Mo., Idaho, Utah, Colo	Alaska, Ariz., Calif., Ill., Kans., Ky., Mont., Nev., N. Mex., N.Y., N.C., Okla., Oreg., Va., Wash., Wis.
Lime	Ohio, Mich., Mo., Pa	Ala., Ariz., Ark., Calif., Colo., Conn., Fla., Hawaii, Idaho, Ill., Iowa, Kans., Ky., La., Md., Mass., Minn., Miss., Mont., Nebr., Nev., N.J., N. Mex., N.Y., Okla., Oreg., S. Dak., Tenn., Tex., Utah, Vt., Va., Wash., W. Va., Wis., Wyo.
Lithium	N.C., Calif	
Magnesite	Nev., Wash., Calif	
Magnesium chloride	Tex	
Magnesium compounds	Mich., Calif., Fla., N.J	Miss., N. Mex., Tex.
Manganese ore	Nev., Mont	
Manganiferous ore	Minn., N. Mex., Mich., Mont	Ariz., Ga.
Marl, greensand	N.J., Md	
Mercury	Calif., Nev., Alaska, Idaho	Ariz., Oreg.
Mica:		
Scrap	N.C., Ga., Ala., S.C	Ariz., Calif., Colo., Conn., Maine, N.H., N. Mex., Pa., S. Dak.
Sheet	N.C., N.H., S. Dak., Maine	Ala., Conn., Ga., Mont., S.C., Va., Wyo.
Molybdenum	Colo., Utah, Ariz., N. Mex	Calif., Nev.
Natural gas	Tex., La., Okla., N. Mex	Ala., Alaska, Ark., Calif., Colo., Fla., Ill., Ind., Kans., Ky., Md., Mich., Miss., Mo., Mont., Nebr., N.Y., N. Dak., Ohio, Pa., Tenn., Utah, Va., W. Va., Wyo.

TABLE 3.—Minerals produced in the United States and principal producing States in 1961—Continued

Mineral	Principal producing States, in order of quantity	Other producing States
Natural gas liquids	Tex., La., Okla., Calif.	Ark., Colo., Ill., Kans., Ky., Mich., Miss., Mont., Nebr., N. Mex., N. Dak., Pa., Utah, W. Va., Wyo.
Nickel	Oreg., Mo.	
Olivine	Wash., N.C.	
Peat	Mich., Ind., Wash., Calif.	Colo., Conn., Fla., Ga., Idaho, Ill., Iowa, Md., Mass., Minn., Mont., N.H., N.J., N.Y., Ohio, Pa., S.C., Wis.
Perlite	N. Mex., Nev., Ariz., Calif.	Colo., Idaho, Utah.
Petroleum	Tex., La., Calif., Okla.	Ala., Alaska, Ariz., Ark., Colo., Fla., Ill., Ind., Kans., Ky., Mich., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N. Dak., Ohio, Pa., S. Dak., Tenn., Utah, Va., Wash., W. Va., Wyo.
Phosphate rock	Fla., Tenn., Idaho, Mont.	Utah, Wyo.
Platinum-group metals	Alaska, Calif.	
Potassium salts	N. Mex., Calif., Utah, Mich.	Md.
Pumice	Ariz., Calif., N. Mex., Hawaii	Colo., Idaho, Kans., Nebr., Nev., Okla., Oreg., Tex., Utah, Wash., Wyo.
Pyrites	Tenn., Calif., Va., Colo.	Ariz., Pa., S.C.
Rare-earth metals	Fla., Calif.	
Salt	La., Tex., N.Y., Mich.	Ala., Calif., Colo., Hawaii, Kans., Nev., N. Mex., N. Dak., Ohio, Okla., Utah, Va., W. Va.
Sand and gravel	Calif., Mich., Wis., Ohio	All other States.
Silver	Idaho, Ariz., Utah, Mont.	Alaska, Calif., Colo., Ky., Mo., Nev., N. Mex., N.Y., N.C., Oreg., Pa., S. Dak., Tenn., Wash., Wyo.
Sodium carbonate	Wyo., Calif.	
Sodium sulfate	Calif., Tex., Wyo.	
Staurolite	Fla.	
Stone	Pa., Tex., Ill., Calif.	All other States.
Sulfur (Frasch)	Tex., La.	
Sulfur ore	Calif., Nev.	
Talc, soapstone, and pyrophyllite.	N.Y., Calif., N.C., Tex.	Ala., Ark., Ga., Md., Mont., Nev., Pa., Vt., Va., Wash.
Tin	Colo.	
Titanium	N.Y., Fla., Va., Idaho	
Tripoli	Ill., Okla., Pa.	
Tungsten	Calif., N.C., Colo., Mont.	Idaho, Nev., Wash.
Uranium	N.Mex., Wyo., Colo., Utah	Alaska, Ariz., Idaho, Mont., Nev., Oreg., S. Dak., Tex., Wash.
Vanadium	Colo., Utah., Ariz., Wyo.	Idaho, N. Mex., S. Dak.
Vermiculite	Mont., S.C., Wyo.	
Wollastonite	N.Y., Calif.	
Zinc	Tenn., Idaho, N.Y., Colo.	Ariz., Ark., Calif., Ill., Kans., Ky., Mo., Mont., Nev., N.J., N. Mex., Okla., Oreg., Pa., Utah, Va., Wash., Wis.
Zirconium	Fla.	

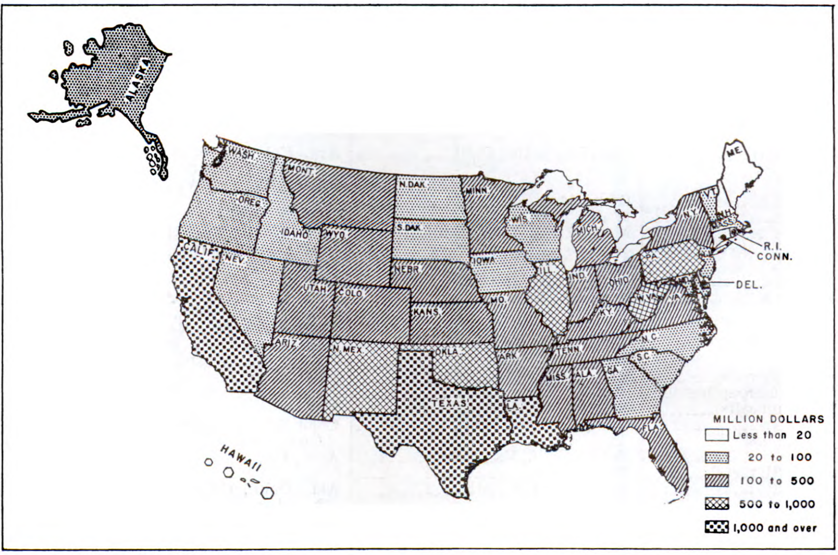

FIGURE 2.—Value of mineral production in the United States, 1961, by States

TABLE 4.—Value of mineral production in the United States, and principal minerals produced in 1961

(Thousand dollars)

State	1958	1959	1960	1961			
				Value	Rank	Percent of U.S. total	Principal minerals in order of value
Alabama	$188,938	$200,847	$217,507	$214,411	20	1.18	Coal, cement, stone, iron ore.
Alaska	21,450	20,495	21,860	34,733	41	.19	Petroleum, coal, sand and gravel, gold.
Arizona	314,520	326,862	415,512	432,614	13	2.39	Copper, sand and gravel, cement, zinc.
Arkansas	132,520	140,594	158,263	149,138	25	.82	Petroleum, bauxite, stone, cement.
California	1,500,367	1,433,626	1,404,665	1,420,749	3	7.84	Petroleum, natural gas, cement, sand and gravel.
Colorado	306,566	314,677	343,104	343,256	17	1.89	Petroleum, molybdenum, coal, uranium.
Connecticut	13,128	12,930	15,255	16,501	45	.09	Stone, sand and gravel, lime, feldspar.
Delaware	1,142	1,284	989	1,053	50	.01	Sand and gravel, stone, clays, gem stones.
District of Columbia	72	75	71	68	----------	(1)	Clays.
Florida	142,114	163,446	176,923	190,933	23	1.05	Phosphate rock, stone, cement, clays.
Georgia	75,106	86,262	91,203	95,256	29	.53	Clays, stone, cement, sand and gravel.
Hawaii	6,298	7,630	9,254	14,588	47	.08	Stone, cement, sand and gravel, pumice.
Idaho	64,648	70,209	57,441	68,900	35	.38	Silver, lead, zinc, phosphate rock.
Illinois	576,862	572,275	586,364	571,605	8	3.15	Petroleum, coal, stone, sand and gravel.
Indiana	197,677	206,359	208,247	197,965	22	1.09	Coal, cement, petroleum, stone.
Iowa	85,356	88,557	95,030	90,674	30	.50	Cement, stone, sand and gravel, gypsum.
Kansas	503,788	508,077	483,952	485,872	9	2.68	Petroleum, natural gas, cement, stone.
Kentucky	402,121	418,821	413,525	386,013	15	2.13	Coal, petroleum, stone, natural gas.
Louisiana	1,523,370	1,766,269	1,987,967	2,173,442	2	11.99	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	12,574	13,278	13,677	14,969	46	.08	Cement, stone, sand and gravel, mica.
Maryland	45,735	53,189	55,527	62,264	36	.34	Stone, cement, sand and gravel. coal.
Massachusetts	23,887	25,916	27,588	30,234	42	.17	Sand and gravel, stone, lime, clays.
Michigan	343,487	381,297	429,737	442,696	12	2.44	Iron ore, cement, petroleum, sand and gravel.
Minnesota	395,880	347,178	515,255	450,509	11	2.48	Iron ore, sand and gravel, stone, cement.
Mississippi	151,411	186,116	198,449	210,242	21	1.16	Petroleum, natural gas, cement, sand and gravel.
Missouri	144,120	157,189	156,041	145,365	27	.80	Cement, stone, lead, lime.
Montana	176,728	167,328	178,854	183,354	24	1.01	Petroleum, copper, sand and gravel, cement.
Nebraska	90,047	97,130	101,957	103,060	28	.57	Petroleum, cement, sand and gravel, stone.
Nevada	68,291	70,164	80,335	80,565	32	.44	Copper, sand and gravel, iron ore, lime.
New Hampshire	3,919	4,722	5,514	5,388	48	.03	Sand and gravel, mica, stone, feldspar.
New Jersey	50,380	59,479	56,409	59,208	37	.33	Stone, sand and gravel, iron ore, magnesium compounds.
New Mexico	559,777	592,535	653,226	688,908	6	3.80	Petroleum, potassium salts, natural gas, uranium.
New York	205,338	234,642	255,368	228,983	18	1.26	Cement, stone, salt, sand and gravel.
North Carolina	39,891	40,789	45,096	50,124	39	.28	Stone, sand and gravel, copper, tungsten.
North Dakota	59,445	67,342	78,378	84,697	31	.47	Petroleum, sand and gravel, coal, natural gas liquids.
Ohio	344,856	397,326	391,150	368,315	16	2.03	Coal, cement, stone, lime.
Oklahoma	761,936	765,439	780,941	785,973	5	4.34	Petroleum, natural gas, natural gas liquids, cement.

See footnote at end of table.

TABLE 4.—Value of mineral production in the United States, and principal minerals produced in 1961—Continued

(Thousand dollars)

State	1958	1959	1960	1961			
				Value	Rank	Percent of U.S. total	Principal minerals in order of value
Oregon	$45,190	$49,842	$54,520	$54,922	38	.30	Stone, sand and gravel, cement, nickel.
Pennsylvania	882,040	862,150	823,360	791,648	4	4.37	Coal, cement, stone, natural gas.
Rhode Island	2,249	2,333	5,727	3,079	49	.02	Sand and gravel, stone, gem stones.
South Carolina	22,412	30,598	30,001	30,136	43	.17	Stone, cement, clays, sand and gravel.
South Dakota	41,534	48,553	46,780	42,980	40	.24	Gold, cement, sand and gravel, stone.
Tennessee	124,934	140,738	143,475	147,262	26	.81	Stone, cement, coal, zinc.
Texas	4,033,311	4,219,757	4,116,664	4,224,909	1	23.30	Petroleum, natural gas, natural gas liquids, cement.
Utah	367,232	373,515	431,383	406,617	14	2.24	Copper, petroleum, coal, uranium.
Vermont	21,443	23,359	22,879	24,283	44	.13	Stone, asbestos, sand and gravel, talc.
Virginia	203,277	222,501	203,887	221,835	19	1.22	Coal, stone, cement, sand and gravel.
Washington	60,896	63,894	70,485	73,006	33	.40	Cement, sand and gravel, stone, lime.
West Virginia	749,747	737,616	720,601	687,903	7	3.80	Coal, natural gas, natural gas liquids, stone.
Wisconsin	71,334	71,959	77,171	72,886	34	.40	Sand and gravel, stone, iron ore, cement.
Wyoming	369,938	393,841	438,733	466,983	10	2.58	Petroleum, uranium, natural gas, sodium carbonates, and sulfates.
Total	16,529,000	17,241,000	17,896,000	18,131,000		100.00	Petroleum, natural gas, coal, cement.

[1] Less than 0.005 percent.

TABLE 5.—Mineral production [1] in the United States, by States

Mineral	1958 Quantity	1958 Value (thousands)	1959 Quantity	1959 Value (thousands)	1960 Quantity	1960 Value (thousands)	1961 Quantity	1961 Value (thousands)
ALABAMA								
Cement: [2]								
Portland……thousand 376-pound barrels	13,588	$42,930	14,819	$46,639	12,931	$42,706	12,445	$39,027
Masonry……thousand 280-pound barrels							2,006	6,156
Clays [3]……thousand short tons	1,548	1,787	1,786	2,089	1,840	2,170	1,787	2,068
Coal (bituminous)……do	11,182	72,360	11,947	78,212	13,011	92,439	12,915	90,903
Iron ore (usable)……thousand long tons, gross weight	3,659	23,393	4,165	23,922	4,068	23,511	3,597	20,510
Lime……thousand short tons	520	5,851	579	6,847	[4] 536	[4] 6,593	579	6,871
Mica (sheet)……pounds	(5)	(5)	818	7	(5)	(5)	(5)	(5)
Natural gas……million cubic feet	323	30	172	17	57	4	56	4
Petroleum (crude)……thousand 42-gallon barrels	5,887	(5)	5,524	(5)	7,329	(5)	[7] 6,932	[7] 19,063
Sand and gravel……thousand short tons	4,128	4,210	4,352	4,594	4,359	4,759	5,800	6,452
Stone [3]……do	11,080	17,068	11,886	18,728	13,503	19,970	13,651	19,909
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, clays (kaolin), scrap mica, salt, stone (dimension limestone and marble, shell, 1959–61, crushed sandstone 1959–61), talc, and values indicated by footnote 5	------	26,508	------	25,401	------	[4] 29,650	------	7,919
Total Alabama [6]	------	188,938	------	200,847	------	[4] 217,507	------	214,411
ALASKA								
Clays……thousand short tons	------	------	(10)	$1	1	$10	------	------
Coal (bituminous)……do	759	$6,931	660	5,869	722	6,318	737	$5,868
Copper (recoverable content of ores, etc.)……short tons	5	3	36	22	41	26	92	55
Gem stones	(11)	(5)	(11)	18	(11)	(5)	(11)	(5)
Gold (recoverable content of ores, etc.)……troy ounces	186,435	6,525	178,918	6,262	168,197	5,887	114,216	3,998
Lead (recoverable content of ores, etc.)……short tons	2	(5)	------	------	(5)	(5)	(5)	------
Mercury……76-pound flasks	3,380	774	3,743	852	4,459	940	4,129	816
Natural gas……million cubic feet	50	6	133	16	246	30	631	129
Peat……short tons	------	------	------	------	376	(5)	------	------
Petroleum (crude)……thousand 42-gallon barrels	29	(5)	187	295	559	1,230	[7] 6,325	[7] 17,647
Sand and gravel……thousand short tons	4,255	3,871	5,859	5,265	6,013	5,483	5,241	4,185
Silver (recoverable content of ores, etc.)……thousand troy ounces	24	22	21	19	26	23	18	17
Stone……thousand short tons	615	2,065	89	377	275	852	(5)	(5)
Value of items that cannot be disclosed: Platinum-group metals, uranium ore, and values indicated by footnote 5	------	1,253	------	1,499	------	[4] 1,061	------	2,018
Total Alaska	------	21,450	------	20,495	------	[4] 21,860	------	34,733

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ARIZONA								
Beryllium concentrate……short tons, gross weight	18	$10	----------	----------	(12)	(5)	8	$4
Clays [3]……thousand short tons	119	179	120	$179	173	$260	165	240
Coal (bituminous)……thousand short tons	8	54	7	63	6	58	----------	----------
Copper (recoverable content of ores, etc.)……short tons	485,839	255,551	430,297	264,202	538,605	345,784	587,053	352,232
Gem stones……	(11)	86	(11)	88	(11)	120	(11)	119
Gold (recoverable content of ores, etc.)……troy ounces	142,979	5,004	124,627	4,362	143,064	5,007	145,959	5,109
Lead (recoverable content of ores, etc.)……short tons	11,890	2,782	9,999	2,300	8,495	1,988	5,937	1,223
Lime……thousand short tons	126	1,817	123	1,666	148	2,430	167	2,686
Manganese ore (35 percent or more Mn)……short tons gross weight	62,279	5,220	68,183	5,727	1,626	40	----------	----------
Manganiferous ore (5 to 35 percent Mn)……do	1,455	32	10,693	234	8,677	190	(5)	(5)
Mercury……76-pound flasks	53	12	(5)	(5)	(5)	(5)	148	29
Mica (scrap)……short tons	1,717	25	3,069	55	(5)	(5)	(5)	(5)
Molybdenum (content of concentrate)……thousand pounds	2,320	2,827	3,181	4,019	4,359	5,211	4,878	6,232
Petroleum (crude)……thousand 42-gallon barrels	12	(5)	25	(5)	73	(5)	[7] 67	(5)
Pumice……thousand short tons	401	1,025	487	1,153	703	1,164	745	1,893
Sand and gravel……do	12,208	9,526	13,458	11,966	14,490	14,235	21,953	24,706
Silver (recoverable content of ores, etc.)……thousand troy ounces	4,685	4,240	3,898	3,528	4,775	4,322	5,120	4,733
Stone……thousand short tons	1,528	2,731	2,468	3,998	4,249	5,107	3,582	4,626
Uranium ore……short tons	257,756	7,049	253,390	6,309	283,684	6,219	228,225	4,965
Zinc (recoverable content of ores, etc.)……do	28,532	5,821	37,325	8,585	35,811	9,239	29,585	6,804
Value of items that cannot be disclosed: Asbestos, cement, clays (bentonite, fire clay 1961), diatomite (1961), feldspar, fluorspar (1958), gypsum, helium (1961), iron ore (1961), nitrogen compounds (1958), perlite, pyrites, tungsten (1959–60), vanadium, and values indicated by footnote 5……	----------	11,734	----------	9,811	----------	[4] 15,851	----------	18,910
Total Arizona [9]……	----------	314,520	----------	326,862	----------	[4] 415,512	----------	432,614
ARKANSAS								
Barite……short tons	182,779	$1,668	338,539	$3,097	277,851	$2,578	277,855	$2,630
Bauxite……long tons, dried equivalent	1,257,916	[8] 12,311	1,631,643	17,048	1,932,071	20,469	1,178,898	13,462
Clays……thousand short tons	578	1,578	782	2,406	815	2,456	773	1,758
Coal (bituminous)……do	364	2,744	441	3,482	409	3,116	395	2,888
Gem stones……	(11)	23	(11)	18	(11)	38	(11)	19
Gypsum……thousand short tons	(5)	(5)	(5)	(5)	67	208	167	531
Lead (recoverable content of ores, etc.)……short tons	----------	----------	38	9	----------	----------	----------	----------

Lime……thousand short tons	(5)	(5)	(5)	(5)	(5)	(5)	192	3,168
Manganese ore (35 percent or more Mn)……short tons, gross weight	22,221	1,737	17,742	1,398	------	------	------	------
Natural gas……million cubic feet	32,890	2,664	40,674	3,539	55,451	6,599	59,547	8,039
Natural gas liquids:								
Natural gasoline and cycle products……thousand gallons	37,197	2,574	40,730	2,523	34,558	2,148	27,889	1,640
LP gases……do	53,518	2,743	55,731	3,048	73,252	3,735	75,157	3,286
Petroleum (crude)……thousand 42-gallon barrels	28,700	80,934	26,329	72,931	30,117	83,424	[7] 29,249	[7] 80,435
Sand and gravel……thousand short tons	8,644	7,039	11,696	11,857	8,192	10,262	9,389	9,074
Stone……do	8,461	10,178	8,824	10,424	10,939	13,555	12,029	12,402
Zinc (recoverable content of ores, etc.)……short tons	------	------	49	11	50	13	37	9
Value of items that cannot be disclosed: Abrasive stones, bromine, cement, soapstone, and values indicated by footnote 5	------	7,241	------	10,042	------	10,918	------	10,906
Total Arkansas [9]	------	132,520	------	140,594	------	[4] 158,263	------	149,138

CALIFORNIA

Barite……short tons	24,812	$272	28,143	$326	16,157	$181	21,203	$295
Boron minerals……do	528,209	38,310	619,946	46,150	640,591	47,550	602,613	46,936
Cement [2]……thousand 376-pound barrels	39,583	124,367	43,635	138,506	39,712	128,826	41,090	129,836
Chromite……short tons, gross weight	20,588	1,646	(5)	(6)	------	------	------	------
Clays……thousand short tons	2,394	5,012	2,726	5,646	2,899	5,663	3,041	6,405
Copper (recoverable content of ores, etc.)……short tons	749	394	663	407	1,087	698	1,382	829
Feldspar……long tons	71,193	624	76,489	824	76,010	886	(5)	(5)
Gem stones……	(11)	150	(11)	150	(11)	150	(11)	200
Gold (recoverable content of ores, etc.)……troy ounces	185,385	6,489	145,270	5,084	123,713	4,330	97,644	3,418
Gypsum……thousand short tons	1,423	3,184	1,686	3,788	1,616	3,687	1,574	3,673
Lead (recoverable content of ores, etc.)……short tons	140	33	227	52	440	103	103	21
Lime……thousand short tons	262	4,470	358	5,817	345	5,628	518	9,412
Magnesium compounds from sea water and bitterns (partly estimated) short tons, MgO equivalent	74,132	4,854	87,968	6,336	86,532	6,233	90,534	6,467
Manganese ore (35 percent or more Mn)……short tons, gross weight	17,644	1,516	19,354	1,663	------	------	------	------
Manganiferous ore (5 to 35 percent Mn)……do	------	------	129	(5)	96	(5)	------	------
Mercury……76-pound flasks	22,365	5,123	17,100	3,890	18,764	3,955	18,688	3,693
Mica, scrap……short tons	(5)	(5)	------	------	(5)	(5)	950	12
Natural gas……million cubic feet	465,582	108,481	485,655	119,471	517,535	138,182	556,241	157,416
Natural gas liquids:								
Natural gasoline and cycle products……thousand gallons	853,045	68,485	834,258	68,023	794,657	62,496	762,878	57,645
LP gases……do	342,992	18,678	396,331	21,260	408,378	21,482	424,767	21,805
Peat……short tons	28,617	374	34,604	449	33,091	481	46,348	501
Perlite……do	14,883	114	(5)	(5)	(5)	(5)	(5)	(5)
Petroleum (crude)……thousand 42-gallon barrels	313,672	909,649	308,946	787,812	305,352	751,166	[7] 300,062	[7] 729,151
Pumice……thousand short tons	377	1,670	574	2,162	427	1,895	610	2,202
Salt……do	1,297	(5)	1,388	(5)	1,443	(5)	1,601	(5)
Sand and gravel……do	84,137	95,340	87,945	108,909	87,679	107,503	110,181	124,111

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA—Continued								
Silver (recoverable content of ores, etc.)...thousand troy ounces..	188	$170	173	$156	180	$163	93	$86
Stone...thousand short tons..	32,423	48,345	32,134	49,090	33,075	49,842	33,850	50,327
Talc, soapstone, and pyrophyllite...short tons..	129,638	1,339	144,816	1,490	130,539	1,396	161,068	1,524
Wollastonite...do....	1,652	17	(5)	(5)	(5)	(5)	4,075	42
Zinc (recoverable content of ores, etc.)...do....	51	10	78	18	465	120	304	70
Value of items that cannot be disclosed: Asbestos, bromine, calcium-magnesium chloride, carbon dioxide (1959-61), masonry cement, coal (lignite), diatomite, fluorspar (1958, 1960-61), iodine, iron ore, lithium minerals, magnesite, molybdenum, platinum-group metals (crude), potassium salts, pyrites, rare-earth metal concentrates, sodium carbonates and sulfates, strontium minerals (1959), sulfur ore, tungsten concentrate, uranium ore (1958-60), and values indicated by footnote 5......	----------	68,564	----------	73,397	----------	[4] 79,471	----------	81,051
Total California [9]...	----------	1,500,367	----------	1,433,626	----------	[4] 1,404,665	----------	1,420,749
COLORADO								
Beryllium concentrate...short tons, gross weight..	176	$63	221	$67	304	$53	[13] 819	(5)
Carbon dioxide, natural...thousand cubic feet..	(5)	(5)	175,223	(5)	155,871	20	167,872	$19
Clays...thousand short tons..	449	1,111	417	1,160	490	1,424	556	1,241
Coal (bituminous)...do....	2,974	19,305	3,294	21,034	3,607	21,090	3,678	22,787
Columbium-tantalum concentrate [14]...pounds..	2,280	7	----------	----------	----------	----------	----------	----------
Copper (recoverable content of ores, etc.)...short tons..	4,193	2,206	2,940	1,805	3,247	2,085	4,141	2,485
Feldspar...long tons..	34,648	237	(5)	(5)	(5)	(5)	14,129	99
Gem stones....	(11)	38	(11)	43	(11)	45	(11)	36
Gold (recoverable content of ores, etc.)...troy ounces..	79,539	2,784	61,097	2,138	61,269	2,144	67,515	2,363
Gypsum...thousand short tons..	103	341	106	385	82	296	85	320
Iron ore (usable)...thousand long tons, gross weight..	(5)	(5)	11	78	11	80	27	190
Lead (recoverable content of ores, etc.)...short tons..	14,112	3,302	12,907	2,969	18,080	4,231	17,755	3,658
Lime...thousand short tons..	(5)	(5)	(5)	(5)	(5)	(5)	75	1,319
Manganese ore (35 percent or more Mn)...short tons, gross weight..	210	17	1,218	102	----------	----------	----------	----------
Mica, scrap...short tons..	387	6	68	1	340	4	600	10

Natural gas...million cubic feet	82,464	8,659	99,899	10,989	107,404	12,781	108,142	12,544
Natural gas liquids:								
Natural gasoline...thousand gallons	49,505	3,410	47,424	2,811	73,179	4,138	76,880	3,627
LP gases...do	68,027	3,343	77,637	3,671	104,275	4,938	115,410	5,498
Peat...short tons	7,143	41	6,674	35	9,384	37	9,894	44
Petroleum (crude)...thousand 42-gallon barrels	48,736	145,721	46,440	134,676	47,469	137,660	[7] 46,746	[7] 134,628
Pumice...thousand short tons	34	65	40	66	32	70	44	60
Pyrites...thousand long tons	67	359	(5)	(5)	(5)	(5)	(5)	(5)
Rare-earth and thorium concentrates...short tons	650	35	9	1	(12)	(6)	-----	-----
Sand and gravel...thousand short tons	20,626	17,842	20,897	18,817	19,053	16,882	18,360	16,946
Silver (recoverable content of ores, etc.)...thousand troy ounces	2,056	1,860	1,341	1,213	1,659	1,502	1,965	1,817
Stone...thousand short tons	2,930	4,943	2,824	5,537	2,442	4,651	2,451	5,301
Tin (content of ore and concentrate)...long tons	-----	-----	50	60	10	12	(5)	(5)
Uranium ore...short tons	939,706	22,486	1,044,089	22,546	1,149,583	23,462	1,282,462	21,509
Vanadium (recoverable in ore and concentrate)...do	2,396	(5)	2,949	(5)	4,026	(5)	4,149	(5)
Zinc (recoverable content of ores, etc.)...do	37,132	7,575	35,388	8,139	31,278	8,070	42,647	9,809
Value of items that cannot be disclosed: Cement, fluorspar, molybdenum, perlite, salt, tungsten, and values indicated by footnote 5	-----	62,855	-----	79,229	-----	99,743	-----	99,860
Total Colorado [9]	-----	306,566	-----	314,677	-----	[4] 343,104	-----	343,256

CONNECTICUT

Beryllium concentrate...short tons, gross weight	(5)	(5)	13	$8	16	$9	2	$1
Clays...thousand short tons	199	$299	280	368	207	308	[8] 149	[8] 260
Gem stones	(11)	3	(11)	5	(11)	7	(11)	9
Lime...thousand short tons	29	464	(5)	(5)	35	616	33	589
Peat...short tons	1,764	11	2,090	13	(5)	(5)	(5)	(5)
Sand and gravel...thousand short tons	5,019	5,479	4,749	4,912	6,575	5,960	7,499	6,633
Stone...do	4,223	6,863	4,462	7,088	5,057	8,313	5,206	8,616
Value of items that cannot be disclosed: Clay (kaolin 1961), feldspar, sheet mica (1958, 1960–61), and values indicated by footnote 5	-----	89	-----	636	-----	140	-----	491
Total Connecticut [13]	-----	13,128	-----	12,930	-----	15,255	-----	16,501

DELAWARE

Sand and gravel...thousand short tons	1,090	$962	1,241	$1,071	1,084	$907	961	$970
Value of items that cannot be disclosed: Nonmetals	-----	180	-----	213	-----	82	-----	83
Total Delaware	-----	1,142	-----	1,284	-----	989	-----	1,053

See footnotes at end of table.

TABLE 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
FLORIDA								
Clays thousand short tons	450	$5,808	[3] 245	[3] $6,171	[3] 252	[3] $6,357	513	$7,202
Gem stones	----------	----------	(11)	3	(11)	(6)	(11)	(6)
Lime thousand short tons	(5)	(5)	111	1,238	151	2,611	213	3,555
Natural gas million cubic feet	35	5	34	5	30	5	29	5
Peat short tons	36,438	165	34,446	158	39,275	162	24,573	149
Petroleum (crude) thousand 42-gallon barrels	449	(5)	424	(5)	368	(5)	[7] 371	(5)
Phosphate rock thousand long tons	10,851	68,951	11,564	71,208	12,321	82,530	13,789	95,590
Sand and gravel thousand short tons	5,490	4,389	6,674	5,177	6,757	5,559	6,530	5,577
Stone[8] do	23,549	30,983	26,917	35,940	27,629	37,419	28,855	36,305
Titanium concentrate thousand short tons, gross weight	190	5,495	262	7,196	286	7,489	(5)	(5)
Zirconium concentrate short tons	30,302	1,018	(5)	(5)	(5)	(5)	(5)	(5)
Value of items that cannot be disclosed: Cement, clays (kaolin and miscellaneous clay 1959–60), magnesium compounds (1959–61), rare-earth metals concentrates (1958–59, 1961), staurolite, stone (dimension limestone 1958–59, 1961, calcareous marl 1960), and values indicated by footnote 5	----------	28,510	----------	40,034	----------	[4] 38,154	----------	44,797
Total Florida[9]	----------	142,114	----------	163,446	----------	[4] 176,923	----------	190,933
GEORGIA								
Barite short tons	(5)	(5)	(5)	(5)	(5)	(5)	106,914	$2,046
Clays thousand short tons	2,942	$31,253	3,352	$36,232	3,519	$40,160	3,569	42,025
Coal do	9	44	7	34	4	21	4	22
Feldspar long tons	(5)	(5)	(5)	(5)	(5)	(5)	31,128	692
Iron ore (usable) thousand long tons, gross weight	209	1,008	186	945	128	613	162	835
Manganese ore (35 percent of more Mn) short tons, gross weight	(5)	(5)	1,547	(5)	----------	----------	----------	----------
Mica (sheet) pounds	15,102	82	18,461	119	10,218	89	349	3
Peat short tons	4,491	(5)	4,288	(5)	6,904	73	1,032	(5)
Sand and gravel thousand short tons	2,631	2,693	2,909	2,982	3,338	3,047	3,150	3,049
Stone do	12,129	31,108	13,771	35,973	14,297	37,033	15,854	38,077
Talc and soapstone short tons	(5)	(5)	53,692	107	40,200	88	47,950	98
Value of items that cannot be disclosed: Bauxite, cement, gem stones, iron ore (pigment material, 1958–60), manganiferous ore, scrap mica, and values indicated by footnote 5	----------	10,145	----------	10,979	----------	11,181	----------	9,454
Total Georgia[9]	----------	75,106	----------	86,262	----------	91,203	----------	95,256

HAWAII

Cement........thousand 376-pound barrels..	----------	----------	----------	----------	113	$571	1,077	$5,574
Gem stones..........	(11)	(5)	(11)	(5)	(11)	(5)	(11)	18
Lime........thousand short tons..	8	$260	(5)	(5)	(5)	(5)	14	354
Pumice........do....	260	481	276	$548	361	676	324	626
Salt........do....	(10)	(5)	----------	----------	----------	----------	(10)	4
Sand and gravel........do....	438	1,112	463	1,253	490	1,324	416	758
Stone........do....	2,377	4,446	3,034	5,480	3,535	6,443	4,429	7,656
Value of items that cannot be disclosed: Other nonmetals and values indicated by footnote 5........	----------	13	----------	363	----------	353	----------	----------
Total Hawaii [16]........	----------	6,298	----------	7,630	----------	9,254	----------	14,588

IDAHO

Antimony ore and concentrate........short tons, antimony content..	677	(5)	678	(5)	635	(5)	689	(5)
Clays [3]........thousand short tons..	27	$20	39	$33	36	$29	27	$20
Cobalt (content of concentrate)........thousand pounds..	3,078	(5)	1,141	(5)	----------	----------	----------	----------
Columbium-tantalum concentrate........pounds..	422,612	(5)	189,263	(5)	----------	----------	----------	----------
Copper (recoverable content of ores, etc.)........short tons..	9,846	5,179	8,713	5,350	4,208	2,702	4,328	2,597
Gold (recoverable content of ores, etc.)........troy ounces..	15,896	556	10,479	367	6,135	215	5,718	200
Iron ore (usable)........thousand long tons..	1	14	6	56	9	(5)	12	70
Lead (recoverable content of ores, etc.)........short tons..	53,603	12,543	62,395	14,351	42,907	10,040	71,476	14,724
Lime........thousand short tons..	----------	----------	----------	----------	----------	----------	[17] 47	[17] 658
Mercury........76-pound flasks..	2,625	601	1,961	446	1,538	324	1,073	212
Mica:								
Scrap........short tons..	1	(6)	----------	----------	----------	----------	----------	----------
Sheet........pounds..	1,968	14	(5)	(5)	(5)	(5)	----------	----------
Nickel (content of ore and concentrate)........short tons..	29	(5)	(5)	(5)	----------	----------	----------	----------
Phosphate rock........thousand long tons..	1,291	5,652	1,610	7,412	2,177	11,044	1,440	7,984
Pumice........thousand short tons..	108	172	93	137	56	88	60	95
Rare-earth metals concentrates........short tons..	692	(5)	522	80	----------	----------	----------	----------
Sand and gravel........thousand short tons..	6,879	6,404	9,184	8,080	7,088	6,594	7,305	6,793
Silver (recoverable content of ores, etc.)........thousand troy ounces..	15,953	14,438	16,637	15,057	13,647	12,351	17,576	16,249
Stone........thousand short tons..	1,391	1,794	1,079	1,931	1,318	2,141	1,873	3,111
Titanium concentrate........short tons, gross weight..	2,223	(5)	(5)	(5)	2,014	30	1,873	28
Uranium ore........short tons..	(5)	(5)	3,374	30	(5)	(5)	(5)	(5)
Zinc (recoverable content of ores, etc.)........do....	49,725	10,144	55,699	12,811	36,801	9,495	58,295	13,408
Value of items that cannot be disclosed: Barite, cement, clays (fire clay, bentonite 1958, 1960–61, kaolin 1961), abrasive garnet, gem stones, gypsum (1958–59), lime (recycled 1961), peat, perlite (1961), tungsten concentrate (1958, 1961), vanadium (1961), zirconium concentrate (1958), and values indicated by footnote 5. Excludes value of raw materials used in manufacturing cement........	----------	7,117	----------	4,068	----------	2,388	----------	2,751
Total Idaho........	----------	64,648	----------	70,209	----------	57,441	----------	68,900

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ILLINOIS								
Cement:								
Portland....thousand 376-pound barrels..	9,618	$30,858	9,925	$31,794	9,139	$30,732	8,595	$28,301
Masonry....thousand 280-pound barrels..							461	1,420
Clays....thousand short tons..	2,335	5,910	2,229	4,950	2,357	5,479	1,982	4,166
Coal (bituminous)....do....	43,912	176,614	45,466	184,412	45,977	184,087	45,246	177,070
Fluorspar....short tons..	152,087	7,931	112,469	5,908	134,529	6,936	116,908	5,956
Gem stones....	(11)	1	(11)	1	(11)	(5)	(11)	(5)
Lead (recoverable content of ores, etc.)....short tons..	1,610	377	2,570	591	3,000	702	3,430	707
Natural gas....million cubic feet..	12,983	1,921	13,739	1,910	11,666	1,458	9,970	1,276
Natural gas liquids:								
Natural gasoline and cycle products....thousand gallons..	22,380	1,645	(5)	(5)	16,496	1,313	16,956	1,311
LP gases....do....	353,129	20,866	(5)	(5)	358,366	19,941	340,284	16,495
Peat....short tons..	11,588	72	9,117	72	6,179	28	6,597	30
Petroleum (crude)....thousand 42-gallon barrels..	80,275	240,825	76,727	229,414	77,341	228,929	[7] 79,387	[7] 237,367
Sand and gravel....thousand short tons..	29,866	33,453	30,241	33,717	33,138	36,255	31,353	35,098
Stone....do....	35,016	44,245	35,294	45,081	41,721	55,593	36,361	47,939
Zinc (recoverable content of ores, etc.)....short tons..	24,940	5,088	26,815	6,167	29,550	7,624	26,795	6,163
Value of items that cannot be discolsed: Lime, tripoli, and values indicated by footnote 5....	----------	9,573	----------	30,897	----------	[4] 10,797	----------	11,775
Total Illinois [9]....	----------	576,862	----------	572,275	----------	[4] 586,364	----------	571,605
INDIANA								
Abrasive stones....short tons..	10	$10	5	$13	(5)	(5)	5	$14
Cement....thousand 376-pound barrels..	[3] 14,730	[3] 48,858	14,245	47,231	14,052	$48,310	(5)	(5)
Clays....thousand short tons..	1,370	2,477	1,692	2,915	1,822	3,396	1,362	2,446
Coal (bituminous)....do....	15,022	58,506	14,804	59,954	15,538	61,570	15,106	58,815
Natural gas....million cubic feet..	378	59	484	92	342	61	382	77
Peat....short tons..	12,106	145	15,393	202	27,486	290	57,146	502
Petroleum (crude)....thousand 42-gallon barrels..	11,864	35,711	11,554	34,315	12,054	35,439	[7] 11,152	[7] 33,233
Sand and gravel....thousand short tons..	16,862	15,045	20,357	17,924	20,752	18,377	19,577	16,898
Stone....do....	15,394	31,974	18,544	37,682	18,956	34,920	18,001	33,062
Value of items that cannot be disclosed: Cement (masonry and natural cement 1958), gem stones (1961), gypsum, and values indicated by footnote 5.	----------	7,539	----------	8,817	----------	8,569	----------	55,461
Total Indiana [9]....	----------	197,677	----------	206,359	----------	[4] 208,247	----------	197,965

IOWA

Cement:								
Portland……thousand 376-pound barrels	12,675	$41,741	13,170	$44,048	12,517	$44,204	12,108	$41,718
Masonry……thousand 280-pound barrels							557	1,843
Clays……thousand short tons	[3] 837	[3] 1,054	912	1,168	1,022	1,345	1,044	1,426
Coal (bituminous)……do	1,179	4,147	1,180	4,214	1,068	3,845	927	3,323
Gypsum……do	1,230	4,491	1,318	5,587	1,283	5,428	1,239	5,276
Sand and gravel……do	12,411	10,965	13,484	11,658	14,692	13,516	13,391	11,651
Stone……do	21,045	26,138	20,501	25,759	23,185	30,321	22,018	28,916
Value of items that cannot be disclosed: Fire clay (1958), gem stones (1960–61), lime, and peat (1958, 1960–61)	------	633	------	520	------	660	------	845
Total Iowa [9]	------	85,356	------	88,557	------	95,030	------	90,674

KANSAS

Cement:								
Portland……thousand 376-pound barrels	9,600	$30,047	10,405	$32,282	8,162	$26,373	8,028	$25,605
Masonry……thousand 280-pound barrels							379	1,156
Clays……thousand short tons	875	1,145	1,021	1,271	894	1,224	954	1,225
Coal (bituminous)……do	823	3,711	772	3,607	888	4,197	664	3,102
Gem stones	------	------	(11)	1	(11)	(6)	------	------
Helium……thousand cubic feet	27,888	432	21,643	343	21,696	350	23,251	434
Lead (recoverable content of ores, etc.)……short tons	1,299	304	481	111	781	183	1,449	298
Lime……thousand short tons	------	------	------	------	------	------	15	193
Natural gas……million cubic feet	561,816	64,047	604,410	72,529	634,410	74,226	649,083	81,135
Natural gas liquids:								
Natural gasoline……thousand gallons	110,293	6,229	107,814	5,576	115,868	6,694	132,180	5,790
LP gases……do	115,175	5,193	124,874	6,658	127,270	6,343	135,643	5,916
Petroleum (crude)……thousand 42-gallon barrels	119,942	359,826	119,543	347,870	113,453	329,014	[7] 112,241	[7] 324,376
Salt……thousand short tons	1,073	11,348	1,123	13,670	1,213	14,109	[18] 914	[18] 11,409
Sand and gravel……do	10,317	6,769	11,334	7,937	9,710	6,808	11,366	7,781
Stone [8]……do	12,424	15,036	13,999	17,108	11,814	15,031	12,328	16,411
Zinc (recoverable content of ores, etc.)……short tons	4,421	902	1,017	234	2,117	546	2,446	563
Value of items that cannot be disclosed: Natural cement, gypsum, pumice, salt (brine 1961), stone (dimension 1958–59 and crushed sandstone), and values indicated by footnote 5	------	1,627	------	2,012	------	1,436	------	3,204
Total Kansas [9]	------	503,788	------	508,077	------	[4] 483,952	------	485,872

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
KENTUCKY								
Barite ... short tons	----------	----------	26,598	$335	(5)	(5)	3,304	$30
Clays ... thousand short tons	737	$2,957	984	3,595	[3] 951	[3] $2,646	[3] 906	[3] 2,406
Coal (bituminous) ... do	66,312	289,385	62,810	270,139	66,846	282,395	63,032	256,158
Fluorspar ... short tons	25,861	1,201	18,579	887	25,855	1,173	38,898	1,755
Lead (recoverable content of ores, etc.) ... do	516	121	409	94	558	131	656	135
Natural gas ... million cubic feet	72,248	17,412	73,504	17,420	75,329	18,380	70,937	17,592
Natural gas liquids:								
Natural gasoline ... thousand gallons	37,926	2,165	35,868	2,133	(5)	(5)	(5)	(5)
LP gases ... do	150,655	8,491	213,171	12,267	(5)	(5)	(5)	(5)
Petroleum (crude) ... thousand 42-gallon barrels	17,509	51,652	27,272	76,634	21,147	60,268	[7] 18,643	[7] 55,370
Sand and gravel ... thousand short tons	4,685	4,835	5,081	5,568	5,113	5,763	5,582	5,540
Silver (recoverable content of ores, etc.) ... thousand troy ounces	(5)	(5)	(5)	(5)	----------	----------	2	2
Stone ... thousand short tons	12,597	17,360	[8] 16,063	[8] 22,215	[8] 15,810	[8] 21,493	17,085	23,309
Zinc (recoverable content of ores, etc.) ... short tons	1,258	257	673	155	869	224	1,147	264
Value of items that cannot be disclosed: Cement, ball clay (1960–61), gem stones (1960–61), lime (1961), stone (crushed sandstone 1959–60), and values indicated by footnote 5	----------	7,059	----------	8,202	----------	22,080	----------	24,463
Total Kentucky [9]	----------	402,121	----------	418,821	----------	[4] 413,525	----------	386,013
LOUISIANA								
Clays ... thousand short tons	[3] 755	[3] $755	[3] 904	[3] $904	749	$749	645	$645
Lime ... do	(5)	(5)	(5)	(5)	(5)	(5)	927	11,893
Natural gas ... million cubic feet	2,451,587	316,255	2,670,271	411,222	2,988,414	511,019	3,271,857	611,837
Natural gas liquids:								
Natural gasoline and cycle products ... thousand gallons	783,099	50,371	846,110	60,295	875,567	66,214	931,176	61,714
LP gases ... do	410,869	21,435	540,046	25,877	606,023	28,147	806,559	33,214
Petroleum (crude) ... thousand 42-gallon barrels	313,891	1,023,517	362,666	1,145,569	400,832	1,258,138	[7] 424,962	[7] 1,339,905
Salt ... thousand short tons	3,442	18,960	4,807	20,918	4,792	21,959	4,722	23,357
Sand and gravel ... do	15,061	17,119	16,052	20,111	14,319	19,106	12,042	14,833
Stone ... do	5,453	9,532	5,670	10,874	[8] 4,691	[8] 8,882	[8] 4,641	[8] 7,656
Sulfur (Frasch-process) ... thousand long tons	2,028	47,651	2,252	52,779	2,256	52,639	2,352	55,164
Value of items that cannot be disclosed: Cement, clay (bentonite 1958–59), gypsum, stone (crushed miscellaneous 1960–61), and values indicated by footnote 5	----------	20,475	----------	20,286	----------	24,042	----------	15,807
Total Louisiana [10]	----------	1,523,370	----------	1,766,269	----------	[4] 1,987,967	----------	2,173,442

MAINE

Beryllium concentrate...short tons, gross weight..	(12)	(6)	3	$2	(5)	(5)	5	$3
Clays...thousand short tons..	23	$26	25	26	41	$50	43	51
Feldspar...long tons..	13,034	83	(5)	(5)	(5)	(5)	(5)	(5)
Gem stones...	(11)	5	(11)	10	(11)	15	(11)	20
Mica:								
Scrap...short tons..	104	3	157	4	171	6	80	2
Sheet...pounds..	20,097	278	22,360	237	26,842	[4] 303	7,373	88
Sand and gravel...thousand short tons..	8,941	3,746	9,452	3,644	9,833	3,892	8,921	3,796
Stone...do...	880	2,760	819	2,766	1,012	3,851	998	4,694
Value of items that cannot be disclosed: Cement, lime (1958), peat (1958–59), and values indicated by footnote 5...	------------	6,363	------------	7,050	------------	5,991	------------	6,961
Total Maine [16]...	------------	12,574	------------	13,278	------------	[4] 13,677	------------	14,969

MARYLAND

Clays...thousand short tons..	[3] 605	[3] $815	[3] 661	[3] $944	[3] 612	[3] $853	581	$997
Coal (bituminous)...do...	838	3,161	842	3,188	748	2,799	757	2,868
Gem stones...	(11)	2	(11)	2	(11)	2	(11)	3
Lime...thousand short tons..	(5)	(5)	(5)	(5)	(5)	(5)	96	1,302
Natural gas...million cubic feet..	4,266	1,148	4,373	1,181	4,065	1,081	3,578	973
Sand and gravel...thousand short tons..	8,513	11,368	10,034	12,983	10,076	13,221	12,404	16,894
Stone...do...	6,721	14,387	7,445	15,476	7,944	16,962	10,671	21,203
Value of items that cannot be disclosed: Cement, ball clay (1958–60), greensand marl, peat (1961), potassium salts, talc and soapstone, and values indicated by footnote 5...	------------	16,224	------------	21,416	------------	22,779	------------	20,153
Total Maryland [9]...	------------	45,735	------------	53,189	------------	55,527	------------	62,264

MASSACHUSETTS

Clays...thousand short tons..	85	$111	101	$229	83	$71	104	$85
Gem stones...	(11)	(6)	(11)	1	(11)	1	(11)	2
Lime...thousand short tons..	139	2,121	144	2,289	154	2,370	145	2,307
Peat...short tons..	1,014	(5)	773	(5)	(5)	(5)	(5)	(5)
Sand and gravel...thousand short tons..	10,620	10,035	13,210	11,786	14,789	13,013	18,061	14,958
Stone...do...	4,649	12,354	5,102	12,375	5,247	12,782	5,210	13,399
Value of items that cannot be disclosed: Nonmetals and values indicated by footnote 5...	------------	9	------------	6	------------	8	------------	38
Total Massachusetts [16]...	------------	23,887	------------	25,916	------------	27,588	------------	30,234

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MICHIGAN								
Cement:								
Portland……thousand 376-pound barrels	20,912	$70,432	23,026	$77,324	22,361	$77,694	21,948	$75,172
Masonry……thousand 280-pound barrels							1,515	4,467
Clays……thousand short tons	1,663	1,813	1,771	1,937	1,738	1,904	1,817	1,975
Copper (recoverable content of ores, etc.)……short tons	58,005	30,511	55,300	33,954	56,385	36,199	70,245	42,147
Gypsum……thousand short tons	1,331	4,824	1,721	6,595	1,463	5,609	1,295	5,095
Iron ore (usable)……thousand long tons, gross weight	8,111	69,845	7,247	62,921	10,792	95,791	9,384	87,604
Lime……thousand short tons	(5)	(5)	862	11,748	1,177	15,730	1,211	15,960
Manganiferous ore (5 to 35 percent Mn)……short tons, gross weight	112,536	(5)	----------	----------	180,460	(5)	17,083	(5)
Natural gas……million cubic feet	14,243	2,649	18,916	4,350	20,790	4,449	27,697	5,844
Peat……short tons	107,342	1,684	191,661	2,357	214,402	2,755	209,266	2,002
Petroleum (crude)……thousand 42-gallon barrels	9,308	27,366	10,439	30,691	15,899	46,266	[7] 18,898	[7] 55,182
Salt……thousand short tons	4,267	33,018	4,485	35,725	4,088	33,759	3,885	31,284
Sand and gravel……do	39,871	34,616	48,052	41,193	46,910	39,304	54,603	47,790
Stone……do	27,188	26,846	30,095	30,379	31,256	32,274	28,731	30,103
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, gem stones, iodine (1961), magnesium compounds, natural gas liquids, potassium salts, and values indicated by footnote 5	----------	45,558	----------	49,371	----------	45,864	----------	46,186
Total Michigan [9]	----------	343,487	----------	381,297	----------	[4] 429,737	----------	442,696
MINNESOTA								
Clays……thousand short tons	92	$150	153	$267	[8] 125	[8] $163	176	$241
Iron ore (usable)……thousand long tons, gross weight	42,503	354,528	36,109	306,920	54,723	470,874	44,699	407,152
Manganiferous ore (5 to 35 percent Mn)……short tons, gross weight	370,603	(5)	429,102	(5)	441,028	(5)	181,835	(5)
Peat……short tons	(5)	(5)	----------	----------	1,465	72	11,091	181
Sand and gravel……thousand short tons	29,634	21,680	28,486	20,726	30,302	24,611	30,690	24,143
Stone……do	3,519	9,560	3,639	9,461	4,234	10,034	3,957	9,975
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay (1960–61), gem stones, lime, and values indicated by footnote 5	----------	10,154	----------	9,993	----------	[4] 9,767	----------	9,223
Total Minnesota [16]	----------	395,880	----------	347,178	----------	515,255	----------	450,509

MISSISSIPPI

Clays......thousand short tons..	576	$3,338	747	$4,064	1,017	$4,786	1,104	$5,034
Natural gas......million cubic feet..	160,143	22,260	162,095	25,125	172,478	32,426	172,543	32,093
Natural gas liquids:								
Natural gasoline and cycle products......thousand gallons..	25,738	1,658	23,207	1,495	23,648	1,552	25,135	1,625
LP gases......do....	9,208	503	8,141	465	10,151	564	15,510	700
Petroleum (crude)......thousand 42-gallon barrels..	39,512	113,004	49,620	140,921	51,673	146,235	[7] 54,492	[7] 153,667
Sand and gravel......thousand short tons..	6,545	6,240	7,520	7,743	6,181	5,568	5,920	5,903
Stone......do....	[8] 102	[8] 92	[8] 126	[8] 114	807	808	913	1,044
Value of items that cannot be disclosed: Certain metals and nonmetals....	--------	4,820	--------	6,751	--------	7,271	--------	11,070
Total Mississippi [16]......	--------	151,411	--------	186,116	--------	[4] 198,449	--------	210,242

MISSOURI

Barite......short tons..	199,268	$2,666	296,093	$3,924	180,702	$2,588	227,323	$3,052
Cement:								
Portland......thousand 376-pound barrels..	12,116	40,657	13,947	46,974	12,183	42,330	11,839	41,142
Masonry......thousand 280-pound barrels..							437	1,398
Clays......thousand short tons..	2,060	5,986	2,635	6,898	2,540	7,207	2,132	5,040
Coal (bituminous)......do....	2,592	11,111	2,748	11,937	2,890	12,450	2,938	12,567
Copper (recoverable content of ores, etc.)......short tons..	1,429	752	1,065	654	1,087	698	1,479	887
Iron ore (usable)......thousand long tons, gross weight..	387	3,820	349	3,278	365	3,760	341	3,633
Lead (recoverable content of ores, etc.)......short tons..	113,123	26,471	105,165	24,188	111,948	26,196	98,785	20,350
Lime......thousand short tons..	1,173	14,136	1,324	15,714	1,254	14,701	1,173	13.873
Natural gas......million cubic feet..	--------	--------	--------	--------	75	19	90	
Nickel (content of ore and concentrate)......short tons..	763	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Petroleum (crude)......thousand 42-gallon barrels..	84	(5)	75	(5)	75	(5)	[7] 108	(5)
Sand and gravel......thousand short tons..	8,972	9,728	10,279	11,406	10,207	11,601	9,371	10,688
Silver (recoverable content of ores, etc.)......thousand troy ounces..	251	227	340	308	16	14	12	11
Stone......thousand short tons..	24,276	32,878	26,939	36,435	27,180	37,878	25,631	36,577
Zinc (recoverable content of ores, etc.)......short tons..	362	74	92	21	2,821	728	5,847	1,345
Value of items that cannot be disclosed: Native asphalt, cobalt, gem stones, manganese ore (1958), and values indicated by footnote 5......	--------	2,037	--------	2,288	--------	[4] 2,074	--------	792
Total Missouri [9]......	--------	144,120	--------	157,189	--------	[4] 156,041	--------	145,365

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MONTANA								
Chromite .... short tons, gross weight..	119,057	(5)	[19] 105,000	[19] $3,765	[19] 107,000	[19] $3,813	[19] 82,000	[19] $2,939
Clays [8] .... thousand short tons..	23	$19	46	48	63	77	55	76
Coal (bituminous and lignite) .... do....	305	1,475	345	1,478	313	1,188	371	1,207
Copper (recoverable content of ores, etc.) .... short tons..	90,683	47,699	65,911	40,469	91,972	59,046	104,000	62,400
Fluorspar .... do....	53,654	(5)	18,542	(5)	31,273	(5)	14,905	(5)
Gold (recoverable content of ores, etc.) .... troy ounces..	26,003	910	28,551	999	45,922	1,607	35,377	1,238
Iron ore (usable) .... thousand long tons, gross weight..	14	(5)	50			293	34	209
Lead (recoverable content of ores, etc.) .... short tons..	8,434	1,974	7,672	1,765	4,879	1,142	2,643	544
Lime .... thousand short tons..	(5)	(5)	(5)	(5)	(5)	(5)	118	986
Manganese ore (35 percent or more Mn) .... short tons, gross weight..	53,123	4,036	21,604	1,520	29,036	1,996	17,515	1,412
Manganiferous ore (5 to 35 percent Mn) .... do....	(5)	(5)	2,415	34	676	11	2,236	33
Natural gas .... million cubic feet..	27,989	1,903	30,743	2,306	33,418	2,373	33,901	2,509
Peat .... short tons..	----------	----------	----------	----------	----------	----------	7,385	112
Petroleum (crude) .... thousand 42-gallon barrels..	27,957	74,086	29,857	76,434	30,240	72,878	[7] 30,907	[7] 74,795
Sand and gravel .... thousand short tons..	13,432	12,593	10,930	12,587	12,589	11,657	14,702	13,506
Silver (recoverable content of ores, etc.) .... thousand troy ounces..	3,630	3,286	3,420	3,096	3,607	3,265	3,490	3,227
Stone .... thousand short tons..	1,786	2,468	1,186	1,691	1,183	1,576	1,512	1,849
Uranium ore .... short tons..	689	20	2,890	(5)	1,726	29	729	10
Zinc (recoverable content of ores, etc.) .... do....	33,238	6,781	27,848	6,405	12,551	3,238	10,262	2,360
Value of items that cannot be disclosed: Barite, cement, chromite,[19] clays (bentonite 1958–59, fire clay), gem stones, gypsum, sheet mica, natural gas liquids, pyrites (1958–59), phosphate rock, rare-earth metal concentrates (1958–59), talc, tungsten (1960–61), vermiculite, and values indicated by footnote 5	----------	20,318	----------	15,248	----------	15,217	----------	14,854
Total Montana [16]	----------	176,728	----------	167,328	----------	178,854	----------	183,354
NEBRASKA								
Clays .... thousand short tons..	108	$110	131	$133	108	$109	146	$148
Gem stones	(11)	2	(11)	3	(11)	4	(11)	5
Natural gas .... million cubic feet..	11,405	1,711	13,128	2,087	15,258	2,670	15,743	2,629
Natural gas liquids:								
Natural gasoline .... thousand gallons..	10,870	727	(5)	(5)	(5)	(5)	(5)	(5)
LP gases .... do....	31,178	1,565	(5)	(5)	(5)	(5)	(5)	(5)

Petroleum (crude) thousand 42-gallon barrels	20,373	59,897	22,881	65,897	23,825	68,378	24,396	[7] 69,529
Sand and gravel thousand short tons	10,441	7,945	11,202	8,301	10,876	8,746	10,094	8,250
Stone do	3,555	4,747	3,236	5,235	3,336	5,651	3,622	6,324
Value of items that cannot be disclosed: Cement, lime (1961), pumice, and values indicated by footnote 5		14,603		17,679		18,384		18,637
Total Nebraska[9]		90,047		97,130		[4] 101,957		103,060
NEVADA								
Antimony ore and concentrate short tons, antimony content	39	$8	10	$2				
Barite short tons	59,407	403	91,298	623	[4] 86,061	[4] $591	129,524	$863
Copper (recoverable content of ores, etc.) do	66,137	34,788	57,375	35,228	77,485	49,745	78,022	46,813
Fluorspar do	12,338	340	16,743	407	18,505	388	18,129	357
Gem stones	(11)	100	(11)	100	(11)	100	(11)	100
Gold (recoverable content of ores, etc.) troy ounces	105,087	3,678	113,443	3,971	58,187	2,037	54,165	1,896
Gypsum thousand short tons	686	2,306	818	2,738	802	2,721	729	2,625
Iron ore (usable) thousand long tons, gross weight	594	3,149	698	3,712	[4] 740	[4] 3,683	845	4,608
Lead (recoverable content of ores, etc.) short tons	4,150	971	1,357	312	987	231	1,791	369
Manganese ore (35 percent or more Mn) short tons, gross weight	127,322	7,566	56,611	3,918	49,076	3,301	28,573	1,852
Manganiferous ore (5 to 35 percent Mn) do			200	(5)	(5)	(5)		
Mercury 76-pound flasks	7,336	1,681	7,156	1,628	7,821	1,648	7,486	1,480
Perlite short tons	(5)	(5)	(5)	(5)	35,214	286	29,544	240
Petroleum (crude) thousand 42-gallon barrels	40	69	32	(5)	27	(5)	[7] 152	(5)
Sand and gravel thousand short tons	5,503	5,311	6,436	7,522	4,085	5,224	7,095	7,443
Silver (recoverable content of ores, etc.) thousand troy ounces	933	844	611	553	707	640	388	359
Stone thousand short tons	813	1,335	840	1,587	579	1,350	677	1,576
Talc and soapstone short tons	5,391	41	5,824	50	4,882	30	3,090	33
Zinc (recoverable content of ores, etc.) do	91	19	217	50	420	108	453	104
Value of items that cannot be disclosed: Brucite (1958–59), clays, diatomite, lime, magnesite, molybdenum, pumice, salt, sulfur ore, tungsten, uranium ore, and values indicated by footnote 5		6,020		8,458		[4] 8,809		10,811
Total Nevada [10]		68,291		70,164		[4] 80,335		80,565
NEW HAMPSHIRE								
Beryllium concentrate short tons, gross weight	14	$8	20	$12	14	$8	23	$14
Clays thousand short tons	26	26	26	26	27	27	30	30
Feldspar long tons	(5)	(5)	(5)	(5)	(5)	(5)	10,290	62
Gem stones	(11)	5	(11)	10	(11)	15	(11)	(5)
Mica:								
Sheet pounds	81,472	646	119,163	1,133	[4] 72,188	[4] 1,101	62,737	931
Scrap short tons	314	12	(5)	(5)	415	14	669	20
Peat do	100	(5)	25	(5)	23	(5)	15	(5)
Sand and gravel thousand short tons	4,940	2,620	5,124	2,887	6,621	3,687	7,701	3,627
Stone do	(5)	(5)	82	488	104	594	117	684
Value of items that cannot be disclosed: Values indicated by footnote 5		602		166		68		20
Total New Hampshire		3,919		4,722		[4] 5,514		5,388

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW JERSEY								
Clays .... thousand short tons..	684	$2,181	700	$1,895	664	$1,597	657	$1,681
Gem stones	(11)	4	(11)	6	(11)	7	(11)	9
Peat .... short tons..	18,397	185	28,300	278	25,100	192	21,257	212
Sand and gravel .... thousand short tons..	9,877	16,145	11,033	18,620	11,594	19,511	12,257	20,895
Stone .... do....	8,229	19,193	10,079	22,133	10,202	22,814	11,315	24,539
Zinc (recoverable content of ores, etc.)[20] .... short tons..	607	125	----	----	----	----	112	26
Value of items that cannot be disclosed: Iron ore, lime, magnesium compounds, manganiferous residuum, greensand marl, and uranium ore (1960). Excludes limestone used in manufacturing lime	----	12,547	----	16,547	----	12,288	----	11,846
Total New Jersey	----	50,380	----	59,479	----	56,409	----	59,208
NEW MEXICO								
Barite .... short tons..	(5)	(5)	320	$6	492	$10	600	$10
Beryllium concentrate .... short tons, gross weight..	27	$16	11	6	----	----	24	12
Carbon dioxide, natural .... thousand cubic feet..	(5)	(5)	(5)	(5)	230,115	(5)	242,903	(5)
Clays [8] .... thousand short tons..	40	73	45	77	56	132	67	165
Coal (bituminous) .... do....	117	719	149	837	295	1,747	412	2,477
Copper (recoverable content of ores, etc.) .... short tons..	55,540	29,214	39,688	24,369	67,288	43,199	79,606	47,764
Fluorspar .... do....	----	----	200	7	----	----	----	----
Gem stones	(11)	28	(11)	39	(11)	40	(11)	46
Gold (recoverable content of ores, etc.) .... troy ounces..	3,378	118	3,155	110	5,423	190	6,201	217
Gypsum .... thousand short tons..	----	----	----	----	55	193	105	386
Helium .... thousand cubic feet..	29,793	502	16,903	264	43,494	684	42,224	762
Iron ore (usable) .... thousand long tons, gross weight..	(21)	(5)	(21)	(5)	1	27	(21)	(5)
Lead (recoverable content of ores, etc.) .... short tons..	1,117	261	829	191	1,996	467	2,332	480
Lime .... thousand short tons..	21	260	16	209	36	496	25	350
Manganese ore (35 percent or more Mn) .... short tons, gross weight..	28,866	2,333	27,528	2,248	----	----	----	----
Mica:								
Scrap .... short tons..	787	24	210	7	235	7	1,800	52
Sheet .... pounds..	1,791	18	247	2	(5)	(5)	----	----

Natural gas........million cubic feet..	761,446	79,190	739,660	73,966	798,928	85,485	789,662	86,073
Natural gas liquids:								
Natural gasoline and cycle products........thousand gallons..	258,312	15,131	264,133	16,859	321,667	20,412	301,404	18,619
LP gases........do....	458,178	17,331	552,257	22,320	645,116	28,788	656,751	24,154
Perlite........short tons..	202,046	1,790	240,642	2,121	240,593	2,119	245,654	2,159
Petroleum (crude)........thousand 42-gallon barrels..	98,515	293,974	105,692	301,394	107,380	305,895	[7] 112,083	[7] 320,784
Potassium salts........thousand short tons, K_2O equivalent..	1,978	69,106	2,189	74,117	2,440	[4] 82,645	2,523	96,380
Pumice........thousand short tons..	507	959	493	1,023	365	827	339	879
Salt........do....	31	275	36	322	39	331	33	284
Sand and gravel........do....	13,205	11,413	12,460	13,332	7,419	7,459	12,523	10,049
Silver (recoverable content of ores, etc.)........thousand troy ounces..	159	144	159	144	304	275	283	261
Stone........thousand short tons..	1,730	1,507	461	542	1,277	1,692	1,853	2,206
Uranium ore........short tons..	1,888,499	32,264	3,269,826	53,463	3,793,494	61,827	3,631,036	62,482
Zinc (recoverable content of ores, etc.)........do....	9,034	1,843	4,636	1,066	13,770	3,553	22,900	5,267
Value of items that cannot be disclosed: Cement (1960–61) fire clay, molybdenum, magnesium compounds, manganiferous ore, vanadium, and values indicated by footnote 5........	----------	1,345	----------	3,771	----------	5,266	----------	7,237
Total New Mexico [16]........	----------	559,777	----------	592,535	----------	[4] 653,226	----------	688,908
NEW YORK								
Clays........thousand short tons..	1,085	$1,419	1,309	$1,714	1,172	$1,717	1,037	$1,373
Emery........short tons..	7,687	126	8,555	150	8,169	142	6,180	106
Gem stones........	(11)	8	(11)	8	(11)	9	(11)	10
Gypsum........thousand short tons..	834	3,869	919	4,663	755	3,928	663	3,441
Iron ore (usable)........thousand long tons, gross weight..	1,944	25,683	2,044	28,050	2,484	[4] 32,977	1,973	25,548
Lead (recoverable content of ores, etc.)........short tons..	579	135	481	111	775	181	879	181
Natural gas........million cubic feet..	2,808	859	2,915	889	4,990	1,542	5,742	1,694
Peat........short tons..	13,606	117	12,875	138	10,042	146	11,209	123
Petroleum (crude)........thousand 42-gallon barrels..	1,763	7,457	1,970	8,353	1,813	8,412	[7] 1,715	[7] 8,163
Salt........thousand short tons..	3,896	30,609	4,011	30,958	4,008	30,763	4,149	30,761
Sand and gravel........do....	24,730	27,541	27,943	31,415	30,687	35,152	28,043	30,471
Silver (recoverable content of ores, etc.)........thousand troy ounces..	67	60	52	47	49	45	41	37
Stone........do....	22,598	38,219	28,640	46,556	29,802	46,955	26,951	43,734
Zinc (recoverable content of ores, etc.)........short tons..	53,014	10,815	43,464	9,997	66,364	17,122	54,763	12,595
Value of items that cannot be disclosed: Beryllium concentrate (1960–61), cement, abrasive garnet, iron oxide pigments (1958), lime, talc, titanium concentrate, and wollastonite........	----------	61,859	----------	76,904	----------	81,831	----------	76,219
Total New York [9]........	----------	205,338	----------	234,642	----------	[4] 255,368	----------	228,983

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NORTH CAROLINA								
Abrasive stones .... short tons..	(11)	[22] $2	[22] 191	[22] $5	(11)	[22] $2	(11)	[22] $3
Clays [8] .... thousand short tons..	2,046	1,187	2,524	1,522	2,476	1,548	2,603	1,669
Feldspar .... long tons..	(5)	(5)	(5)	(5)	270,761	2,781	251,858	2,477
Gem stones	(11)	1	(11)	9	(11)	4	(11)	6
Gold (recoverable content of ores, etc.) .... troy ounces..	876	31	965	34	1,826	64	2,094	73
Iron ore .... thousand long tons..	....	....	(5)	(5)	(5)	(5)	(5)	1
Lead (recoverable content of ores, etc.) .... short tons..	....	....	....	....	424	99	318	66
Mica:								
Scrap .... do....	50,897	1,041	47,736	1,212	47,281	1,100	53,615	1,010
Sheet .... pounds..	521,701	1,722	505,623	1,755	430,193	[4] 1,539	390,870	2,237
Sand and gravel .... thousand short tons..	7,044	5,880	8,580	7,426	8,801	7,453	9,779	8,467
Silver (recoverable content of ores, etc.) .... thousand troy ounces.	15	14	16	15	212	192	170	157
Stone .... thousand short tons..	12,385	19,132	12,859	20,302	14,721	23,296	15,921	25,262
Talc and pyrophyllite .... short tons..	126,158	614	127,296	647	100,593	549	90,711	367
Value of items that cannot be disclosed: Abrasive stone (grinding pebbles and tube-mill liners, 1958, millstones 1959), asbestos, barite (1961), beryllium concentrate (1958), clay (kaolin), copper, lithium minerals, olivine, tungsten concentrate, and values indicated by footnote 5	....	10,267	....	7,862	....	6,469	....	8,329
Total North Carolina	....	39,891	....	40,789	....	[4] 45,096	....	50,124
NORTH DAKOTA								
Clays .... thousand short tons..	[8] 54	[8] $66	[8] 61	[8] $79	[8] 102	[8] $129	(5)	(5)
Coal (lignite) .... do....	2,314	5,409	2,413	5,426	2,525	5,790	2,726	$6,141
Gem stones	(11)	1	(11)	1	(11)	1	(11)	1
Natural gas .... million cubic feet..	17,325	1,672	17,915	1,774	19,483	2,221	20,100	2,533
Petroleum (crude) .... thousand 42-gallon barrels..	14,259	42,634	17,824	49,907	21,992	59,598	[7] 23,568	[7] 64,105
Pumice .... thousand short tons..	11	11	....	....	....	....	....	....
Sand and gravel .... do....	11,464	6,605	9,883	6,516	8,648	6,904	9,395	7,507
Stone .... do....	23	35	48	84	28	44	40	40
Value of items that cannot be disclosed: Clays (bentonite 1958–60, fire clay 1960), natural gas liquids, salt (1960–61) and values indicated by footnote 5.	....	3,012	....	3,555	....	3,691	....	4,370
Total North Dakota	....	59,445	....	67,342	....	[4] 78,378	....	84,697

OHIO

Abrasive stones, grindstones and pulpstones ... short tons	852	$83	1,081	$101	(5)	(5)	(5)	(5)
Cement:								
Portland ... thousand 376-pound barrels	15,700	53,043	18,994	63,935	17,480	$61,478	15,303	$53,251
Masonry ... thousand 280-pound barrels							846	2,604
Clays ... thousand short tons	5,220	13,082	5,478	15,346	5,165	14,325	4,923	13,790
Coal (bituminous) ... do	32,028	126,241	35,112	135,729	33,957	130,877	32,226	121,343
Gem stones	(11)	(5)	(11)	2	(11)	3	(11)	4
Lime ... thousand short tons	2,411	32,471	3,190	45,121	3,117	44,403	3,123	42,158
Natural gas ... million cubic feet	31,786	6,802	34,664	8,042	36,074	8,477	36,423	9,069
Peat ... short tons	5,660	104	5,813	73	6,755	93	9,113	123
Petroleum (crude) ... thousand 42-gallon barrels	6,260	18,091	5,978	17,157	5,405	16,053	[7] 5,161	[7] 15,947
Salt ... thousand short tons	2,443	17,443	2,858	20,486	3,108	24,149	3,465	25,037
Sand and gravel ... do	29,624	36,619	38,604	45,139	37,943	44,979	33,688	41,272
Stone ... do	29,122	49,782	[8] 36,155	[8] 59,326	[8] 35,856	[8] 59,479	33,652	55,701
Value of items that cannot be disclosed: Gypsum, natural gasoline (1958), stone (dimension limestone 1960, and calcareous marl 1959–60), and values indicated by footnote 5	----------	1,905	----------	2,027	----------	1,826	----------	1,566
Total Ohio [9]	----------	344,856	----------	397,326	----------	[4] 391,150	----------	368,315

OKLAHOMA

Clays [3] ... thousand short tons	576	$579	966	$970	734	$739	792	$801
Coal (bituminous) ... do	1,629	10,858	1,525	10,272	1,342	9,113	1,032	6,784
Helium ... thousand cubic feet	----------	----------	98,749	1,619	289,068	4,691	313,244	5,872
Lead (recoverable content of ores, etc.) ... short tons	3,692	864	601	138	936	219	980	202
Natural gas ... million cubic feet	696,504	70,347	811,508	81,151	824,266	98,088	892,697	108,016
Natural gas liquids:								
Natural gasoline and cycle products ... thousand gallons	440,798	26,029	448,353	29,443	531,995	33,074	521,237	33,358
LP gases ... do	657,114	25,822	675,869	27,070	762,258	32,409	817,082	30,141
Petroleum (crude) ... thousand 42-gallon barrels	200,699	594,069	198,090	578,423	192,913	563,306	[7] 191,834	[7] 558,237
Salt ... thousand short tons	4	41	(5)	(5)	3	16	3	19
Sand and gravel ... do	7,232	5,859	6,002	5,927	6,424	7,468	5,310	5,513
Stone ... do	10,794	12,232	12,683	14,980	[8] 14,054	[8] 16,098	14,981	16,561
Zinc (recoverable content of ores, etc.) ... short tons	5,267	1,074	1,049	241	2,332	602	3,148	724
Value of items that cannot be disclosed: Native asphalt (1958–60), clay (bentonite), cement, gem stones (1959–61), gypsum, lime, pumice, stone (crushed granite 1960), tripoli, and values indicated by footnote 5	----------	16,022	----------	18,156	----------	16,756	----------	21,920
Total Oklahoma [9]	----------	761,936	----------	765,439	----------	[4] 780,941	----------	785,973

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OREGON								
Chromite……short tons, gross weight	4,133	(5)	------	------	------	------	------	------
Clays……thousand short tons	252	$293	294	$308	318	$370	294	$357
Copper (recoverable content of ores, etc.)……short tons	10	5	------	------	6	4	(5)	(5)
Gold (recoverable content of ores, etc.)……troy ounces	1,423	50	686	24	835	29	1,054	37
Lead (recoverable content of ores, etc.)……short tons	1	(6)	------	------	------	------	(5)	(5)
Lime……thousand short tons	(5)	(5)	------	------	(5)	(5)	221	5,157
Mercury……76-pound flasks	2,276	521	1,224	278	513	108	138	27
Nickel (content of ore and concentrate)……short tons	12,697	(5)	12,374	(5)	13,115	5,246	12,860	(5)
Pumice……thousand short tons	138	331	(5)	(5)	(5)	(5)	203	461
Sand and gravel……do	10,464	10,265	18,087	15,506	17,673	16,170	12,299	13,680
Silver (recoverable content of ores, etc.)……thousand troy ounces	3	2	(24)	(6)	(24)	(6)	2	2
Stone……thousand short tons	15,077	15,621	13,341	16,126	[4] 16,913	[4] 19,721	17,272	20,939
Uranium ore……short tons	------	------	------	------	(5)	(5)	2,160	66
Zinc (recoverable content of ores, etc.)……do	------	------	------	------	------	------	3	1
Value of items that cannot be disclosed: Asbestos (1959–61), carbon dioxide, (1958–60), cement, diatomite, gem stones, iron ore (pigment material, 1959, 1961), and values indicated by footnote 5	------	19,311	------	18,607	------	14,124	------	15,557
Total Oregon [9]	------	45,190	------	49,842	------	[4] 54,520	------	54,922
PENNSYLVANIA								
Cement:								
Portland……thousand 376-pound barrels	42,115	$142,399	43,356	$150,918	38,320	$131,763	36,635	$124,506
Masonry……thousand 280-pound barrels							2,678	7,232
Clays……thousand short tons	[3] 3,318	[3] 17,051	3,466	17,196	[3] 3,557	[3] 16,536	[3] 2,999	[3] 14,402
Coal:								
Anthracite……do	21,171	187,898	20,649	172,320	18,817	147,116	17,446	140,338
Bituminous……do	67,771	373,812	65,347	345,332	65,425	345,971	62,652	323,758
Cobalt (content of concentrate)……thousand pounds	564	(5)	280	(5)	(5)	(5)	(5)	(5)
Gem stones	(11)	2	(11)	3	(11)	4	(11)	5
Lime……thousand short tons	1,003	14,161	1,263	18,261	1,120	16,277	1,124	16,896

Natural gas million cubic feet	95,869	27,131	99,366	29,015	113,928	36,229	100,427	29,526
Natural gas liquids:								
Natural gasoline thousand gallons	1,608	107	2,884	184	1,399	85	1,272	74
LP gases do	1,363	123	1,484	36	1,580	138	1,453	115
Peat short tons	23,623	203	26,948	262	30,837	325	27,993	291
Petroleum (crude) thousand 42-gallon barrels	6,472	26,535	6,160	25,872	6,009	27,341	[7] 5,622	[7] 26,490
Sand and gravel thousand short tons	11,825	19,180	14,257	23,233	13,011	21,204	12,594	19,766
Stone do	40,049	69,694	43,682	77,421	42,136	74,168	41,834	71,344
Zinc (recoverable content of ores, etc.)[20] short tons	10,812	2,229	16,718	3,828	13,746	3,559	23,428	5,408
Value of items that cannot be discolsed: Clays (kaolin 1958, 1960–61), copper, gold, graphite (1959–61), iron ore, scrap mica, pyrites, pyrophyllite and soapstone, silver, tripoli, and values indicated by footnote 5		15,960		15,812		17,430		25,355
Total Pennsylvania [9]		882,040		862,150		[4] 823,360		791,648
RHODE ISLAND								
Sand and gravel thousand short tons	2,038	$1,883	1,740	$1,588	1,535	$1,355	1,726	$1,666
Stone do	[8] 3	[8] 8	(5)	(5)	1,810	4,372	(5)	(5)
Value of items that cannot be disclosed: Nonmetals and values indicated by footnote 5		358		745				1,413
Total Rhode Island		2,249		2,333		5,727		3,079
SOUTH CAROLINA								
Clays thousand short tons	929	$5,157	1,160	$5,920	1,297	$6,201	1,346	$6,169
Mica (sheet) pounds	1,144	8	251	3	101	1	12	(6)
Peat short tons	4,865	(5)	4,194	(5)	(5)	(5)	(5)	(5)
Sand and gravel thousand short tons	2,946	2,858	3,104	3,077	3,029	3,048	2,904	3,067
Stone do	[8] 3,637	[8] 5,229	[8] 6,248	[8] 8,647	7,327	10,593	6,752	9,827
Zirconium concentrate short tons	141	5						
Value of items that cannot be disclosed: Barite, cement, feldspar (1959–61), gem stones (1958), kyanite, scrap mica, pyrites (1960–61), rare-earth metal concentrates (1958), staurolite (1958), stone (crushed limestone 1958–59, crushed sandstone 1959, calcareous marl 1958–59), titanium (1958), vermiculite, and values indicated by footnote 5		9,586		13,640		[4] 11,144		12,311
Total South Carolina [16]		22,412		30,598		30,001		30,136

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
SOUTH DAKOTA								
Beryllium concentrate....short tons, gross weight..	240	$129	156	$84	167	$88	238	$130
Clays [3]....thousand short tons..	155	155	227	227	202	202	249	249
Coal (lignite)....do....	20	78	22	88	20	83	18	75
Columbium-tantalum concentrate....pounds..	4,294	10	------	------	------	------	------	------
Copper (recoverable content of ores, etc.)....short tons..	------	------	------	------	1	1	------	------
Feldspar....long tons..	23,229	145	30,825	196	45,588	292	29,354	186
Gem stones....	(11)	16	(11)	20	(11)	20	(11)	18
Gold (recoverable content of ores, etc.)....troy ounces..	570,830	19,979	577,730	20,221	554,771	19,417	557,855	19,525
Gypsum....thousand short tons..	12	49	19	78	22	89	22	89
Iron ore (usable)....thousand long tons..	------	------	------	------	(5)	(5)	22	100
Mica:								
Scrap....short tons..	1,003	24	158	5	205	10	1,054	32
Sheet....pounds..	16,772	68	38,775	158	30,887	145	18,086	37
Petroleum (crude)....thousand 42-gallon barrels..	58	(5)	151	(5)	281	(4)	[7] 234	(5)
Sand and gravel....thousand short tons..	14,705	9,179	17,775	11,058	13,548	9,359	11,324	7,336
Silver (recoverable content of ores, etc.)....thousand troy ounces..	153	138	124	113	108	98	127	118
Stone....thousand short tons..	1,395	4,095	2,721	7,243	3,149	7,909	2,806	6,642
Uranium ore....short tons..	35,489	530	45,734	606	41,104	586	43,588	495
Value of items that cannot be disclosed: Cement, clays (bentonite), lime, lithium minerals (1958–60), vanadium (1960–61), and values indicated by footnote 5....	------	7,555	------	9,401	------	9,376	------	8,978
Total South Dakota [9]....	------	41,534	------	48,553	------	46,780	------	42,980
TENNESSEE								
Cement:								
Portland....thousand 376-pound barrels..	8,375	$26,408	9,153	$28,934	8,246	$27,384	8,357	$26,964
Masonry....thousand 280-pound barrels..							1,018	2,753
Clays....thousand short tons..	935	4,210	1,146	4,952	1,270	4,537	[3] 1,040	[3] 4,190
Coal (bituminous)....do....	6,785	25,969	5,913	23,581	5,930	21,154	5,860	20,681
Copper (recoverable content of ores, etc.)....short tons..	9,109	4,791	11,490	7,055	12,723	8,168	12,272	7,363
Gem stones....	(11)	1	(11)	(6)	(11)	1	(11)	1

Gold (recoverable content of ores, etc.)......troy ounces..	124	4	99	3	123	4	152	5
Iron ore (usable)......thousand long tons, gross weight..	(5)	(5)	21	111	(5)	(5)	(5)	(5)
Manganese ore (35 percent or more Mn)......short tons, gross weight..	5,935	452	7,586	589	283	15	------	------
Manganiferous ore (5 to 35 percent Mn)......do....	------	------	56	1	(5)	(5)	------	------
Natural gas......million cubic feet..	54	9	52	9	63	11	71	13
Petroleum (crude)......thousand 42-gallon barrels..	7	(5)	6	(5)	20	(5)	[7] 18	(5)
Phosphate rock......thousand long tons..	1,903	13,041	1,755	13,255	1,939	15,424	2,235	18,675
Sand and gravel......thousand short tons..	5,612	6,671	6,221	7,570	6,293	7,655	6,232	8,046
Silver (recoverable content of ores, etc.)......thousand troy ounces..	44	40	60	54	65	58	83	77
Stone......thousand short tons..	[8] 16,850	[8] 26,814	18,767	29,094	20,074	29,942	23,940	35,906
Zinc (recoverable content of ores, etc.)......short tons..	59,130	12,062	89,932	20,684	91,394	23,579	81,734	18,799
Value of items that cannot be disclosed: Barite, clay (fuller's earth 1961), lime, scrap mica (1958–60), pyrites, stone (crushed sandstone 1958, dimension limestone 1958) and values indicated by footnote 5......	------	6,884	------	7,392	------	[4] 7,606	------	7,241
Total Tennessee [9]......	------	124,934	------	140,738	------	[4] 143,475	------	147,262

TEXAS

Cement:								
Portland......thousand 376-pound barrels..	25,875	$79,756	27,991	$88,067	23,365	$76,577	25,101	$80,808
Masonry......thousand 280-pound barrels..							851	2,529
Clays [3]......thousand short tons..	3,720	5,424	3,870	5,703	3,302	5,058	3,786	5,737
Gem stones......	(11)	100	(11)	100	(11)	100	(11)	150
Gypsum......thousand short tons..	1,240	4,120	1,351	4,770	1,131	3,960	1,074	3,846
Helium......thousand cubic feet..	294,452	4,807	238,113	3,918	120,921	2,044	173,066	3,196
Lime......thousand short tons..	691	7,146	809	8,530	821	9,087	880	9,736
Natural gas......million cubic feet..	5,178,073	517,807	5,718,993	617,651	5,892,704	665,876	5,963,605	733,523
Natural gas liquids:								
Natural gasoline and cycle products......thousand gallons..	2,871,589	204,501	2,790,155	209,238	2,880,906	207,583	3,111,427	214,279
LP gases......do....	3,786,575	151,896	4,353,368	181,148	4,476,142	200,478	4,768,222	185,558
Petroleum (crude)......thousand 42-gallon barrels..	940,166	2,872,389	971,978	2,893,146	927,479	2,748,735	[7] 938,017	[7] 2,787,925
Salt......thousand short tons..	3,843	15,115	4,519	17,498	4,756	18,222	4,695	17,682
Sand and gravel......do....	32,871	30,808	35,295	34,726	29,844	30,754	27,398	30,691
Stone......do....	36,076	40,912	42,172	47,787	39,029	45,088	38,316	45,874
Sulfur (Frasch-process)......thousand long tons..	2,616	61,621	2,970	68,998	2,747	62,855	2,730	62,720
Talc and soapstone......short tons..	60,827	168	60,945	283	67,031	336	78,214	376
Value of items that cannot be disclosed: Abrasive stones (1959), native asphalt, barite (1961), bromine, clay (fuller's earth), coal (lignite), feldspar, graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury (1958–60), pumice (1958, 1961), sodium sulfate, and uranium ore......	------	46,891	------	48,544	------	49,666	------	50,923
Total Texas [9]......	------	4,033,311	------	4,219,757	------	[4] 4,116,664	------	4,224,909

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
UTAH								
Asphalt and related bitumens, native: Gilsonite……short tons	317,280	$4,864	379,362	$9,385	383,037	$10,020	(5)	(5)
Carbon dioxide, natural……thousand cubic feet	90,207	6	69,625	5	60,425	4	78,136	$5
Clays……thousand short tons	[3] 157	[3] 488	[3] 185	[3] 484	[3] 143	[3] 416	143	1,080
Coal (bituminous)……do	5,328	30,340	4,545	27,982	4,955	31,458	5,159	31,126
Copper (recoverable content of ores, etc.)……short tons	189,184	99,511	144,715	88,855	218,049	139,987	213,534	128,120
Fluorspar……do	16,109	564	(5)	(5)	1,912	51	610	18
Gem stones	(11)	40	(11)	134	(11)	72	(11)	73
Gold (recoverable content of ores, etc.)……troy ounces	307,824	10,774	239,517	8,383	368,255	12,889	342,988	12,005
Iron ore (usable)……thousand long tons, gross weight	3,514	25,202	2,842	19,979	3,334	23,862	3,533	25,493
Lead (recoverable content of ores, etc.)……short tons	40,355	9,443	36,630	8,425	39,398	9,219	40,894	8,424
Lime……thousand short tons	80	1,513	90	1,773	127	2,672	142	2,626
Manganese ore (35 percent or more Mn)……short tons, gross weight	1,043	84	1,511	124				
Mica (sheet)……pounds	12	(6)						
Natural gas……million cubic feet	19,247	2,829	38,921	5,527	51,040	9,187	57,175	8,976
Natural gasoline……thousand gallons	240	15	(5)	(5)	(5)	(5)	(5)	(5)
Petroleum (crude)……thousand 42-gallon barrels	24,811	74,185	39,959	114,283	37,594	103,008	[7] 33,118	[7] 91,075
Pumice……thousand short tons	41	84	39	81	60	134	60	95
Salt……do	184	2,275	209	2,453	231	3,092	249	3,187
Sand and gravel……do	25,304	14,379	8,843	6,436	6,848	6,182	14,060	8,448
Silver (recoverable content of ores, etc.)……thousand troy ounces	5,278	4,777	3,734	3,380	4,783	4,329	4,798	4,435
Stone……thousand short tons	13,126	13,949	3,338	4,048	1,837	3,087	1,808	3,219
Uranium ore……short tons	1,239,767	38,583	1,210,654	37,310	1,089,757	27,843	1,098,783	25,734
Vanadium (recoverable in ore and concentrate)……do	376	(5)	536	(5)	462	(5)	514	(5)
Zinc (recoverable content of ores, etc.)……do	44,982	9,176	35,223	8,101	35,476	9,153	37,239	8,565
Value of items that cannot be disclosed: Barite (1959–61), cement, clay (kaolin 1958–60), gypsum, molybdenum, LP gases (1959–61), perlite, phosphate rock, potassium salts, pyrites (1959–60), and values indicated by footnote 5		25,214		27,396		36,047		45,554
Total Utah [16]		367,232		373,515		[4] 431,383		406,617
VERMONT								
Copper (recoverable content of ores, etc.)……short tons	475	$250						
Gem stones	(11)	1	(11)	$1	(11)	$1	(11)	$2
Sand and gravel……thousand short tons	1,882	1,316	2,320	1,590	1,809	1,218	2,232	1,567
Silver (recoverable content of ores, etc.)……thousand troy ounces	5	5						
Stone……thousand short tons	808	15,789	944	17,372	2,114	17,444	2,731	18,715
Value of items that cannot be disclosed: Asbestos, clays, lime, and talc		4,106		4,420		4,240		4,012
Total Vermont [16]		21,443		23,359		22,879		24,283

VIRGINIA

Aplite......long tons	(5)	(5)	(5)	(5)	(5)	(5)	97,465	$651
Clays......thousand short tons	1,153	$1,143	1,346	$1,396	1,348	$1,395	1,406	1,332
Coal (bituminous)......do	26,826	130,319	29,769	139,224	27,838	122,723	30,332	126,121
Gem stones......	(11)	3	(11)	4	(11)	5	(11)	6
Lead (recoverable content of ores, etc.)......short tons	2,934	687	2,770	637	2,152	504	3,733	769
Lime......thousand short tons	471	5,533	765	8,168	711	8,028	739	8,596
Manganese ore (35 percent or more Mn)......short tons, gross weight	8,128	647	6,232	499	----------	----------	----------	----------
Manganiferous ore (5 to 35 percent Mn)......do	56	1	(5)	(5)	----------	----------	----------	----------
Mica, sheet......pounds	147	2	108	1	103	1	(5)	(5)
Natural gas......million cubic feet	2,521	681	2,280	597	2,227	604	2,466	668
Petroleum (crude)......thousand 42-gallon barrels	4	(5)	6	(5)	2	(5)	[7] 6	(5)
Sand and gravel......thousand short tons	7,158	10,834	8,452	12,369	7,666	11,432	9,839	14,697
Silver (recoverable content of ores, etc.)......thousand troy ounces	2	2	1	1	----------	----------	----------	----------
Stone......thousand short tons	15,413	27,504	17,787	31,447	19,358	33,019	22,934	39,206
Zinc (recoverable content of ores, etc.)[16]......short tons	18,472	3,808	20,334	4,662	19,885	5,142	29,163	6,726
Value of items that cannot be disclosed: Cement, feldspar, gypsum, iron ore (pigment materials 1960–61), kyanite, pyrites, salt, talc and soapstone, titanium concentrate, and values indicated by footnote 5......	----------	25,471	----------	28,848	----------	[4] 26,027	----------	27,757
Total Virginia [9]......	----------	203,277	----------	222,501	----------	[4] 203,887	----------	221,835

WASHINGTON

Abrasive stone: Pebbles (grinding)......short tons	18	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Barite......do	(5)	(5)	(5)	(5)	(5)	(5)	5,100	$42
Chromite......short tons, gross weight	17	$2	----------	----------	----------	----------	----------	----------
Clays [8]......thousand short tons	196	183	180	$171	169	$162	145	138
Coal (bituminous)......do	252	1,968	242	1,841	228	1,721	191	1,381
Copper (recoverable content of ores, etc.)......short tons	52	27	49	30	78	50	66	40
Gem stones......	(11)	75	(11)	(5)	(11)	(5)	(11)	(5)
Iron ore (usable)......thousand long tons	4	(5)	4	5	----------	----------	----------	----------
Lead (recoverable content of ores, etc.)......short tons	9,020	2,111	10,310	2,371	7,725	1,808	8,053	1,659
Lime......thousand short tons	----------	----------	----------	----------	----------	----------	[17] 349	[17] 8,481
Manganese ore (35 percent or more Mn)......short tons, gross weight	----------	----------	83	(5)	----------	----------	----------	----------
Peat......short tons	34,642	116	32,884	124	27,770	121	55,543	359
Petroleum (crude)......thousand 42-gallon barrels	4	(5)	1	(5)	1	(5)	(25)	(5)
Pumice......thousand short tons	(5)	(5)	9	112	(5)	(5)	(5)	(5)
Sand and gravel......do	24,389	20,086	21,360	18,576	[4] 25,594	[4] 19,459	18,994	16,145
Stone......do	7,837	9,991	12,278	13,587	13,897	15,796	11,464	14,758
Talc and soapstone......short tons	4,000	21	4,073	23	2,406	12	2,927	23
Uranium ore......do	(5)	(5)	152,336	(5)	171,255	3,223	175,327	3,582
Zinc (recoverable content of ores, etc.)......do	18,797	3,835	17,111	3,936	21,317	5,500	20,217	4,650
Value of items that cannot be disclosed: Carbon dioxide, cement, fire clay, diatomite, epsom salts (1961), gold, lime (recycled 1961), magnesite, mercury (1958), olivine, silver, strontium minerals (1958–59), tungsten (1961), and values indicated by footnote 5......	----------	24,128	----------	25,054	----------	24,552	----------	23,666
Total Washington [9]......	----------	60,896	----------	63,894	----------	[4] 70,485	----------	73,006

See footnotes at end of table.

TABLE 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WEST VIRGINIA								
Clays...thousand short tons	510	$1,960	596	$2,492	626	$2,639	475	$2,193
Coal (bituminous)...do	119,468	635,201	119,692	621,003	118,944	597,222	113,070	558,525
Gem stones	------------	------------	(11)	1	(11)	1	(11)	1
Natural gas...million cubic feet	204,581	50,734	204,633	53,205	208,757	54,694	210,556	57,692
Natural gas liquids:								
Natural gasoline...thousand gallons	27,917	5,643	29,242	1,808	23,211	1,513	34,095	2,296
LP gases...do	235,524	12,806	308,316	15,534	329,874	16,527	342,646	17,826
Petroleum (crude)...thousand 42-gallon barrels	2,186	7,629	2,184	7,862	2,300	9,361	[7] 2,703	[7] 11,190
Salt...thousand short tons	627	2,784	811	3,305	920	3,673	899	3,510
Sand and gravel...do	5,253	11,729	4,854	10,513	4,506	9,802	4,882	10,152
Stone...do	[8] 5,599	[8] 9,990	[8] 5,923	[8] 10,482	[8] 8,001	[8] 14,001	7,628	13,244
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, cement, lime, stone (crushed sandstone 1958, dimension sandstone 1959-60, calcareous marl 1959)	------------	13,067	------------	13,318	------------	13,195	------------	13,385
Total West Virginia [9]	------------	749,747	------------	737,616	------------	[4] 720,601	------------	687,903
WISCONSIN								
Abrasive stones...short tons	858	$26	770	$27	397	$12	560	$17
Clays...thousand short tons	154	167	178	192	144	156	126	130
Iron ore (usable)...thousand long tons, gross weight	867	(5)	701	(5)	1,502	(5)	1,122	(5)
Lead (recoverable content of ores, etc.)...short tons	800	187	745	171	1,165	273	680	140
Lime...thousand short tons	141	2,193	(5)	(5)	(5)	(5)	161	2,480
Peat...short tons	(5)	(5)	7,500	(5)	8,500	(5)	(5)	(5)
Sand and gravel...thousand short tons	39,383	25,845	41,999	27,535	35,681	25,648	39,978	28,457
Stone...do	13,722	23,334	13,522	23,782	16,486	22,302	13,418	19,686
Zinc (recoverable content of ores, etc)...short tons	12,140	2,477	11,635	2,676	18,410	4,750	13,865	3,189
Value of items that cannot be disclosed: Cement, gem stones, and values indicated by footnote 5	------------	18,083	------------	18,541	------------	25,619	------------	19,649
Total Wisconsin [9]	------------	71,334	------------	71,959	------------	77,171	------------	72,886

WYOMING

Beryllium concentrate........short tons, gross weight..	17	$9	1	(6)	5	$2	2	$1
Clays [3]........thousand short tons..	1,075	9,968	764	$9,449	788	9,571	859	10,301
Coal........do....	1,629	5,820	1,977	6,669	2,024	6,992	2,529	8,573
Copper (recoverable content of ores, etc.)........short tons..	(12)	(6)	------------	------------	------------	------------	1	1
Gem stones........	(11)	52	(11)	76	(11)	68	(11)	83
Gold (recoverable content of ores, etc.)........troy ounces..	117	4	------------	------------	40	1	1	(6)
Gypsum........thousand short tons..	6	19	9	31	13	46	(5)	(5)
Iron ore (usable)........thousand long tons, gross weight..	557	(5)	503	2,923	(5)	(5)	(5)	(5)
Natural gas........million cubic feet..	121,682	10,221	156,978	12,715	181,610	21,793	194,674	24,334
Natural gas liquids:								
Natural gasoline........thousand gallons..	49,451	3,052	64,586	4,003	72,195	4,535	76,349	4,705
LP gases........do....	54,496	2,614	90,314	3,951	120,693	5,279	132,831	5,451
Petroleum (crude)........thousand 42-gallon barrels..	115,572	301,643	126,050	315,125	133,910	336,114	[7] 142,589	[7] 356,473
Phosphate rock........thousand long tons..	124	937	(5)	(5)	(5)	(5)	(5)	(5)
Pumice........thousand short tons..	45	40	94	77	33	30	20	20
Sand and gravel........do....	5,333	4,760	4,692	3,982	5,928	5,356	6,669	5,356
Stone........do....	1,099	1,472	1,317	1,791	1,401	2,302	2,594	3,315
Uranium ore........short tons..	651,790	13,286	864,582	17,610	1,357,225	27,387	1,521,064	28,218
Value of items that cannot be disclosed: Cement, clays (fire clay 1958–59, 1961, miscellaneous clay 1959–61), feldspar (1958), lime (1961), sheet mica (1959–61), silver (1958, 1960–61), sodium carbonates and sulfates, vanadium (1958, 1960–61), vermiculite (1961), and values indicated by footnote 5....	------------	16,760	------------	15,970	------------	[4] 19,780	------------	21,046
Total Wyoming [9]........	------------	369,938	------------	393,841	------------	[4] 438,733	------------	466,983

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[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes certain cement, included with "Value of items that cannot be disclosed."

[3] Excludes certain clays, included with "Value of items that cannot be disclosed."

[4] Revised figure.

[5] Figure withheld to avoid disclosing individual company confidential data.

[6] Less than $500.

[7] Preliminary figure.

[8] Excludes certain stone, included with "Value of items that cannot be disclosed."

[9] Total adjusted to eliminate duplicating value of clays and stone.

[10] Less than 500 short tons.

[11] Weight not recorded.

[12] Less than 0.5 ton.

[13] Includes 805 tons of low-grade beryllium ore.

[14] Total weight of columbite-tantalite plus $(Cb\text{-}Ta)_2O_5$ content of euxenite.

[15] Total value adjusted to eliminate duplicating value of stone.

[16] Total has been adjusted to eliminate duplicating value of raw materials used in manufacturing cement and/or lime.

[17] Excludes recycled lime, included with "Value of items that cannot be disclosed."

[18] Excludes salt in brine, included with "Value of items that cannot be disclosed."

[19] Excludes quantity consumed by American Chrome Co.

[20] Recoverable zinc valued at the yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at mine.

[21] Less than 500 long tons.

[22] Millstones only.

[23] Grinding pebbles and tubemill liners.

[24] Less than 500 troy ounces.

[25] Less than 500 barrels.

TABLE 6.—Mineral production [1] in the Canal Zone and islands administered by the United States [2]

Area and mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa: Stone ....thousand short tons..	30	$59	178	$219	523	$261	362	$286
Canal Zone:								
Sand and gravel ....do....	41	34	14	21	65	68	75	73
Stone (crushed) ....do....	140	237	223	270	203	306	163	271
Total Canal Zone	----------	271	----------	291	----------	374	----------	344
Canton:								
Sand and gravel ....thousand short tons..	----------	----------	(3)	(4)	----------	----------	----------	----------
Stone (crushed) ....do....	----------	----------	(3)	1	----------	----------	----------	----------
Guam:								
Sand and gravel ....do....	9	23	28	20	1	1	38	49
Stone ....do....	684	751	568	1,109	962	2,194	292	591
Total Guam	----------	774	----------	1,129	----------	2,195	----------	640
Johnston:								
Sand and gravel ....thousand short tons..	----------	----------	----------	----------	1	4	1	1
Stone ....do....	----------	----------	----------	----------	2	5	1	2
Total Johnston	----------	----------	----------	----------	----------	9	----------	3
Midway: Stone (crushed) ....thousand short tons..	175	476	----------	----------	----------	----------	11	34
Virgin Islands: Stone (crushed) ....do....	25	81	14	51	15	51	20	75
Wake: Stone (crushed) ....do....	10	37	32	34	36	49	24	62

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[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Production data for Canton and Wake furnished by U.S. Department of Commerce, Civil Aeronautics Administration; Midway and Johnston, by U.S. Department of the Navy; Guam by the Government of Guam; American Samoa, by the Government of American Samoa.

[3] Less than 500 short tons.

[4] Less than $500.

TABLE 7.—Mineral production [1] in the Commonwealth of Puerto Rico

Mineral	1958		1959		1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement......thousand 376-pound barrels..	4,748	$15,175	5,392	$16,982	5,441	$14,546	5,931	$16,946
Clays......thousand short tons..	165	83	167	83	160	102	184	112
Lime......do....	(2)	(2)	10	321	1	15	1	15
Salt......do....	1	14	3	38	----------	----------	----------	----------
Sand and gravel......do....	476	763	530	888	8,996	8,669	11,370	10,385
Stone......do....	1,986	2,768	2,063	2,878	4,219	7,661	5,049	7,284
Value of items that cannot be disclosed: Other nonmetals and values indicated by footnote 2......	----------	272	----------	----------	----------	74	----------	----------
Total Puerto Rico [4]......	----------	17,689	----------	19,700	----------	[3] 29,603	----------	33,805

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[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Revised figure.

[4] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement.

TABLE 8.—U.S. imports for consumption of principal minerals and products

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Metal……short tons	154,706	$75,808	199,223	$91,187
Scrap……do	5,042	1,598	6,002	1,738
Plates, sheets, bars, etc……do	36,677	25,872	49,310	33,062
Antimony:				
Ore (antimony content)……do	6,455	1,214	6,713	1,389
Needle and liquated……do	24	11	13	6
Metal……do	5,437	2,495	4,912	2,347
Oxide……do	2,368	972	1,980	935
Arsenic: White (As_2O_3 content)……do	12,825	1,046	19,483	1,422
Bauxite: Crude……thousand long tons	[1] [2] 8,739	[1] 78,024	[2] 9,206	88,821
Beryllium ore……short tons	8,943	2,864	8,516	2,786
Bismuth (general imports)……pounds	1,167,019	2,131	798,518	1,498
Boron carbide……do	85,965	172	11,992	37
Cadmium:				
Metal……thousand pounds	942	1,157	1,079	1,473
Flue dust (cadmium content)……do	1,861	778	239	112
Calcium:				
Metal……pounds	12,618	15	17,266	23
Chloride……short tons	1,570	62	3,022	103
Chromate:				
Ore and concentrate (Cr_2O_3 content)……do	[1] 571,067	[1] 24,313	563,140	21,444
Ferrochrome (chromium content)……do	34,186	14,313	18,698	7,611
Metal……do	908	1,645	692	1,150
Cobalt:				
Metal……thousand pounds	10,801	17,093	10,036	14,867
Oxide (gross weight)……do	1,459	1,520	681	663
Salts and compounds (gross weight)……do	230	104	159	59
Columbium ore……pounds	[2] 5,066,514	[2] 3,696	[2] 2,973,769	[2] 2,527
Copper: (copper content)				
Ore……short tons	3,503	2,016	2,587	1,526
Concentrates……do	20,935	12,391	21,914	12,516
Regulus, black, coarse……do	185	80	95	57
Unrefined, black, blister……do	486	311	5,929	3,508
Refined in ingots, etc……do	171,021	[1] 109,490	87,206	51,852
Old and scrap……do	1,836	1,106	1,643	870
Old brass and clippings……do	309	184	390	173
Ferroalloys: Ferrosilicon (silicon content) short tons	4,972	1,533	2,307	803
Gold:				
Ore and base bullion……troy ounces	460,579	16,080	456,139	15,938
Bullion……do	8,861,716	318,952	1,159,320	40,273
Iron ore:				
Ore……thousand long tons	[1] 34,578	[1] 321,919	25,805	250,226
Pyrites cinder……long tons	5,884	20	3,504	18
Iron and steel:				
Pig iron……short tons	330,847	18,351	377,180	20,511
Iron and steel products (major):				
Iron products……do	[1] 41,356	[1] 8,688	31,157	5,794
Steel products……do	[1] 3,528,459	[1] 485,802	3,277,319	418,268
Scrap……do	138,687	5,281	235,350	8,315
Tinplate scrap……do	[1] 40,714	[1] 992	33,039	770
Lead:				
Ore, flue dust, matte (lead content)……do	[1] 137,303	27,816	136,860	24,347
Base bullion (lead content)……do	293	[2] 62	236	[2] 51
Pigs and bars (lead content)……do	[1] 213,347	[1] 45,065	247,327	45,863
Reclaimed, scrap, etc. (lead content)……do	5,598	1,034	3,894	592
Sheets, pipe, and shot……do	2,855	696	2,845	641
Babbitt metal and solder (lead content) short tons	1,512	16,024	1,409	14,207
Type metal and antimonial lead (lead content)……short tons	[1] 3,915	[1] 970	5,765	1,340
Manufactures……do	2,097	710	2,319	807
Magnesium:				
Metallic and scrap……do	401	202	1,005	483
Alloys (magnesium content)……do	28	288	31	170
Sheets, tubing, ribbons, wire, and other forms (magnesium content)……short tons	4	61	5	80
Manganese:				
Ore (35 percent or more manganese) (manganese content)……short tons	[1] 1,082,362	[1] 82,307	1,031,062	78,144
Ferromanganese (manganese content) short tons	92,594	19,008	[2] 170,199	[2] 34,396

See footnotes at end of table.

TABLE 8.—U.S. imports for consumption of principal minerals and products—Con.

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Mercury:				
Compounds...pounds	114,305	$ 302	90,724	$228
Metal...76-pound flasks	19,488	3,510	12,313	2,048
Minor metals: Selenium and salts...pounds	175,761	972	127,482	738
Nickel:				
Ore and matte...short tons	184	73	(3)	(4)
Pigs, ingots, shot, cathodes...do	79,662	116,567	115,985	169,656
Scrap...do	135	113	278	175
Oxide...do	[2] 24,584	[2] 27,650	14,613	14,137
Platinum group:				
Unrefined materials:				
Ore and concentrates...troy ounces	401	30	568	39
Grains and nuggets, including crude, dust, and residues...troy ounces	30,338	2,201	29,997	2,181
Sponge and scrap...do	3,095	212	11,550	689
Osmiridium...do	----------	----------	2,601	66
Refined metal:				
Platinum...do	238,307	18,917	236,859	18,165
Palladium...do	368,256	8,189	571,693	12,672
Iridium...do	4,253	283	4,366	286
Osmium...do	277	17	466	26
Rhodium...do	31,722	4,126	17,394	2,328
Ruthenium...do	3,997	156	8,969	388
Radium:				
Radium salts...milligrams	23,333	364	12,947	185
Radioactive substitutes	(5)	1,394	(5)	1,509
Rare earths: Ferrocerium and other cerium alloys...pounds	21,391	78	22,955	63
Silver:				
Ore and base bullion thousand troy ounces	43,404	38,164	34,559	30,832
Bullion...do	17,253	15,797	15,697	14,173
Tantalum: Ore...pounds	[2] 695,222	[2] 1,127	[2] 808,082	[2] 1,780
Tin:				
Ore (tin content)...long tons	14,026	31,104	8,917	21,923
Blocks, pigs, grains, etc...do	[1] 39,538	[1] 86,334	39,898	96,909
Dross, skimmings, scrap, residues, and tin alloys, n.s.p.f...long tons	809	1,642	612	1,299
Tinfoil, powder, flitters, etc	(5)	839	(5)	676
Titanium:				
Ilmenite...short tons	265,645	5,067	195,836	4,604
Rutile...do	29,235	3,611	27,497	2,544
Metal...pounds	4,461,737	4,866	4,980,356	5,352
Ferrotitanium...do	166,053	41	364,721	93
Compounds and mixtures...do	12,258,035	2,413	18,044,423	3,536
Tungsten: (tungsten content)				
Ore and concentrate ...thousand pounds	3,525	3,478	[2] 2,123	[2] 1,983
Metal...pounds	159,759	370	55,613	139
Ferrotungsten...thousand pounds	167	207	340	422
Other alloys...pounds	36,666	62	9,955	15
Zinc:				
Ore (zinc content)...short tons	[1] 382,938	[1] 38,704	357,653	31,920
Blocks, pigs, and slabs...do	120,925	29,639	125,186	27,540
Sheets...do	04	302	1,183	354
Old, dross, and skimmings...do	1,205	189	1,410	178
Dust...do	19	7	86	28
Manufactures	(5)	837	(5)	787
Zirconium: Ore, including zirconium sand short tons	34,280	1,234	33,805	873
Nonmetals:				
Abrasives: Dimonds (industrial)...carats	[1] 13,146,094	[1] 51,836	14,209,446	68,545
Asbestos...short tons	669,496	63,345	616,552	58,942
Barite:				
Crude and ground...do	[1] 641,728	[1] 5,008	615,128	5,690
Witherite (crude)...do	[1] 1,344	59	[2] 1,716	67
Chemicals...do	4,986	576	4,565	543
Bromine...pounds	145,943	111	300,491	196
Cement...376-pound barrels	[1] 4,108,273	10,306	3,620,685	9,225
Clays:				
Raw...short tons	153,349	2,985	153,833	2,955
Manufactured...do	6,666	118	2,339	105
Cryolite...do	17,246	1,670	13,814	1,194
Feldspar: Crude...long tons	44	5	24	2
Fluorspar...short tons	534,020	14,393	505,759	13,644

See footnotes at end of table.

TABLE 8.—U.S. imports for consumption of principal minerals and products—Con.

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Gem stones:				
Diamonds...carats	2,167,474	[1] $165,555	3,114,073	$193,275
Emeralds...do	81,207	1,463	227,284	2,090
Other	(5)	25,470	(5)	27,350
Graphite...short tons	48,324	1,755	29,748	1,332
Gypsum:				
Crude, ground, calcined...do	[1] 5,302,383	[1] 9,038	4,968,188	9,094
Manufactures	(5)	1,388	(5)	1,212
Iodine, crude...thousand pounds	1,894	1,425	3,017	2,852
Kyanite...short tons	6,052	265	5,415	244
Lime:				
Hydrated...do	[1] 676	15	950	22
Other...do	18,445	369	31,418	491
Dead-burned dolomite...do	[2] 12,932	[2] 550	4,256	233
Magnesium:				
Magnesite...do	[2] 118,780	7,789	56,521	3,839
Compounds...do	14,971	546	15,435	518
Mica:				
Uncut sheet and punch...pounds	1,088,021	2,081	852,648	1,841
Scrap...short tons	6,240	86	3,024	41
Manufactures...do	4,266	6,139	3,823	6,117
Mineral-earth pigments: Iron oxide pigments:				
Natural...do	2,976	132	2,248	114
Synthetic...do	7,516	1,100	4,806	777
Ocher, crude and refined...do	230	14	91	5
Siennas, crude and refined...do	649	64	546	57
Umber, crude and refined...do	2,894	98	2,685	93
Vandyke brown...do	195	14	168	13
Nitrogen compounds (major), including urea...do	[1] 1,214,088	[1] 55,631	1,434,926	63,924
Phosphate, crude...long tons	129,290	3,754	134,004	3,629
Phosphatic fertilizers...do	[1] 17,450	[1] 1,079	32,467	2,453
Pigments and salts:				
Lead pigments and salts...short tons	15,729	3,224	18,155	3,498
Zinc pigments and salts...do	15,582	3,052	12,608	2,354
Potash...do	[1] [6] 414,803	[1] [6] 15,370	[6] 465,057	[6] 17,327
Pumice:				
Crude or unmanufactured...do	6,556	58	6,907	69
Wholly or partly manufactured...do	3,916	103	4,063	116
Manufactures, n.s.p.f.	(5)	36	(5)	19
Quartz crystal (Brazilian pebble)...pounds	1,193,257	615	1,173,560	798
Salt...short tons	1,057,028	4,484	1,050,084	3,755
Sand and gravel:				
Glass sand...do	10,765	37	2	2
Other sand...do	379,673	516	335,005	441
Gravel...do	3,752	5	43,287	44
Sodium sulfate...thousand short tons	167	3,473	196	4,153
Stone, including slate and whiting	(5)	11,344	(5)	12,268
Strontium: Mineral...short tons	[1] 6,186	150	9,931	244
Sulfur and pyrites:				
Sulfur:				
Ore...long tons	[1] 103,281	[1] 2,268	94,181	1,934
Other forms, n.e.s...do	[1] 638,089	13,185	737,336	15,218
Pyrites...do	[1] 306,216	[1] 1,075	281,604	742
Talc: Unmanufactured...short tons	23,975	849	27,355	[2] 1,054
Fuels:				
Carbon black:				
Acetylene...pounds	6,785,095	1,303	8,073,544	1,482
Gas black and carbon black...do	719,164	134	557,327	111
Coal:				
Anthracite...short tons	1,476	16	792	10
Bituminous, slack, culm, and lignite...do	260,495	1,844	164,259	1,360
Briquets...do	[1] 5,529	[1] 375	7,338	370
Coke...do	[1] 126,345	[1] 1,498	126,518	1,543
Peat:				
Fertilizer grade...do	254,794	13,011	243,834	12,620
Poultry and stable grade...do	9,083	498	8,603	558

See footnotes at end of table.

TABLE 8.—U.S. imports for consumption of principal minerals and products—Con.

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Fuels—Continued				
Petroleum:				
Crude ......thousand barrels..	400,846	[1] $895,055	411,968	$933,310
Gasoline [7] ......do....	[1] 19,350	[1] 64,667	16,313	52,478
Kerosine [8] ......do....	70	224	425	1,524
Distillate oil [8] ......do....	9,792	[1] 30,798	13,661	39,617
Residual oil [8] ......do....	230,396	[1] 482,471	229,468	500,286
Unfinished oils ......do....	20,430	55,847	25,802	69,978
Asphalt ......do....	6,257	14,379	6,728	15,646
Miscellaneous [8] ......do....	76	631	20	465

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[1] Revised figure.
[2] Adjusted by Bureau of Mines.
[3] Less than 1 ton.
[4] Less than $1,000.
[5] Weight not recorded.
[6] Data covers some quantities furnished by Potash Institute; values adjusted by Bureau of Mines.
[7] Includes naphtha but excludes benzol, 1960—[1] 907,649 barrels ([1] $9,181,905); 1961—460,839 barrels ($5,476,518).
[8] Includes quantities imported free of duty for supplies of vessels and aircraft.

Compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign Activities, Bureau of Mines, from records of the U.S. Department of Commerce, Bureau of the Census.

TABLE 9.—U.S. exports of principal minerals and products

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Ingots, slabs, crude ......short tons..	284,979	$128,199	128,861	$57,638
Scrap ......do....	79,513	26,905	82,005	26,452
Plates, sheets, bars, etc ......do....	18,098	16,266	25,241	23,975
Castings and forgings ......do....	1,190	2,849	1,203	3,560
Antimony: Metals and alloys, crude ......do....	59	47	34	21
Arsenic: Calcium arsenate ......pounds..	289,700	21	669.932	58
Bauxite, including bauxite concentrates long tons..	29,317	2,588	150,683	12,189
Aluminum sulfate ......short tons..	12,286	451	14,213	535
Other aluminum compounds ......do....	35,144	5,503	55,610	8,060
Beryllium ......pounds..	131,648	1,344	123,349	645
Bismuth: Metals and alloys ......do....	156,636	276	167,166	268
Cadmium ......thousand pounds..	2,448	3,014	702	983
Calcium chloride ......short tons..	26,792	1,068	22,047	1.091
Chrome:				
Ore and concentrate:				
Exports ......do....	5,184	320	10,465	516
Reexports ......do....	19,927	721	40,483	1,560
Chromic acid ......do....	982	546	1,068	604
Ferrochrome ......do....	15,588	5,249	7,844	2,838
Cobalt ......pounds..	1,798,218	1,313	2,075,243	1,881
Columbium metals, alloys, and other forms short tons..	159,309	157	69,863	151
Copper:				
Ore, concentrate, composition metal, and unrefined copper (copper content) do....	11,111	6,832	4,478	2,475
Refined copper and semimanufactures do....	[1] 510,494	[1] 327,936	486,359	295,397
Other copper manufactures ......do....	5,181	4,006	7,362	5,260
Copper sulfate or blue vitriol ......do....	14,841	3,377	7,575	1,542
Copper base alloys ......do....	[1] 130,140	[1] 69,564	124,938	70,240
Ferroalloys:				
Ferrosilicon ......pounds..	11,002,848	867	69,528,561	6,105
Ferrophosphorus ......do....	95,794,790	2,095	60,120,159	1,307
Gold:				
Ore and base bullion ......troy ounces..	9,196	322	13,717	480
Bullion, refined ......do....	37,676	1,326	22,132,692	774,521
Iron ore ......thousand long tons..	[1] 5,273	57,899	4,916	53,823

See footnotes at end of table.

TABLE 9.—U.S. exports of principal minerals and products—Continued

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Iron and steel:				
Pig iron ... short tons	111,773	$5,174	415,668	$19,243
Iron and steel products (major):				
Semimanufactures ... do	[1] 2,336,969	[1] 445,167	1,428,367	274,888
Manufactured steel mill products short tons	[1] 910,115	[1] 258,444	798,005	253,073
Advanced products	([2])	157,686	([2])	160,126
Iron and steel scrap: Ferrous scrap, including rerolling materials ... short tons	[1] 8,039,668	[1] 241,572	9,715,755	354,017
Lead:				
Ore, matte, base bullion (lead content) short tons	1,297	168	4,437	448
Pigs, bars, anodes ... do	1,967	748	2,133	518
Scrap ... do	2,579	361	5,163	940
Magnesium:				
Metal and alloys and semifabricated forms, n.e.c ... short tons	5,125	3,695	6,648	4,519
Powder ... do	7	23	33	78
Manganese:				
Ore and concentrate ... do	5,139	719	7,528	1,054
Ferromanganese ... do	751	202	469	146
Mercury:				
Exports ... 76-pound flasks	357	83	285	71
Reexports ... do	317	62	180	33
Molybdenum:				
Ore and concentrate (molybdenum content) ... pounds	30,244,496	39,847	35,661,001	48,758
Metals and alloys, crude and scrap ... do	295,004	368	440,849	433
Wire ... do	9,639	278	12,488	376
Semifabricated forms, n.e.c ... do	4,940	74	7,362	135
Powder ... do	9,620	32	11,816	40
Ferromolybdenum ... do	424,819	489	358,523	501
Nickel:				
Ore ... short tons	1	4	1,766	495
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc ... short tons	52,468	27,128	51,631	24,969
Catalysts ... do	761	1,240	805	1,456
Nickel-chrome electric resistance wire short tons	235	969	254	1,079
Semifabricated forms, n.e.c ... do	644	2,322	1,037	3,980
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap ... troy ounces	49,497	3,212	41,385	2,089
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap) ... troy ounces	15,652	504	20,460	820
Platinum group manufactures, except jewelry	([2])	2,978	([2])	2,983
Radium metal (radium content) ... milligrams	712	17	334	18
Rare earths:				
Cerium ore, metal, and alloys ... pounds	15,410	15	6,563	30
Lighter flints ... do	27,517	118	20,338	89
Silver:				
Ore and base bullion thousand troy ounces	291	266	654	597
Bullion, refined ... do	26,302	24,236	39,174	36,361
Tantalum:				
Ore, metal, and other forms ... pounds	49,965	555	232,088	1,041
Powder [3] ... do	1,174	49	5,585	189
Tin:				
Ingots, pigs, bars, etc.:				
Exports ... long tons	608	1,294	543	1,264
Reexports ... do	249	549	257	626
Tin scrap and other tin bearing material except tinplate scrap ... long tons	4,397	1,355	10,506	3,352
Tin cans finished or unfinished ... do	32,875	17,362	30,929	15,093

See footnotes at end of table.

TABLE 9.—U.S. exports of principal minerals and products—Continued

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Titanium:				
Ore and concentrate...short tons	1,260	$167	1,436	$190
Sponge (including iodide titanium) and scrap...short tons	879	869	886	927
Intermediate mill shapes...do	359	2,038	336	1,929
Mill products, n.e.c...do	67	1,200	48	773
Ferrotitanium...do	245	157	212	93
Dioxide and pigments...do	33,655	10,001	31,104	9,216
Tungsten: Ore and concentrate:				
Exports...short tons	633	1,251	207	250
Reexports...do	[1] 229	[1] 343	689	791
Vanadium ore and concentrate, pentoxide, etc. (vanadium content)...pounds	7,379,432	14,124	[3] 4,161,978	[3] 7,658
Zinc:				
Ore and concentrate (zinc content) short tons	13	3	1,670	124
Slabs, pigs, or blocks...do	75,144	18,122	50,055	11,196
Sheets, plates, strips, or other forms, n.e.c. short tons	3,324	2,443	3,219	2,271
Scrap (zinc content)...do	12,169	1,499	5,900	871
Dust...do	777	267	717	224
Semifabricated forms, n.e.c...do	2,569	1,195	3,036	1,317
Zirconium:				
Ore and concentrate...do	1,382	317	1,277	278
Metals and alloys and other forms pounds	[1] 384,406	[1] 2,595	178,873	1,472
Nonmetals:				
Abrasives:				
Grindstones...short tons	319	56	123	46
Diamond dust and powder...carats	321,373	845	490,327	1,357
Diamond grinding wheels...do	264,942	1,567	285,425	1,708
Other natural and artificial metallic abrasives and products	(2)	24,082	(2)	26,084
Asbestos: Unmanufactured:				
Exports...short tons	5,461	845	3,572	708
Reexports...do	64	12	227	51
Boron: Boric acid, borates, crude and refined pounds	601,211,757	25,576	538,542,810	23,212
Bromine, bromides, and bromates...do	10,241,178	2,898	11,120,085	2,980
Cement...376-pound barrels	187,304	1,135	285,816	1,387
Clays:				
Kaolin or china clay...short tons	79,965	2,044	98,785	2,395
Fire clay...do	177,578	3,305	155,166	3,391
Other clays...do	[1] 272,158	[1] 8,365	304,858	8,499
Cryolite...do	226	66	167	41
Fluorspar...do	458	38	338	30
Graphite:				
Amorphous...do	1,377	181	1,328	186
Crystalline flake, lump or chip...do	164	51	91	34
Natural, n.e.c...do	314	57	139	37
Gypsum:				
Crude, crushed or calcined thousand short tons	17	687	20	731
Manufactures, n.e.c	(2)	606	(2)	568
Iodine, iodide, iodates...thousand pounds	251	353	176	282
Kyanite and allied minerals...short tons	3,255	210	4,000	318
Lime...do	61,056	992	29,969	921
Mica:				
Unmanufactured...pounds	701,926	113	334,221	142
Manufactured:				
Ground or pulverized...do	7,077,245	370	7,074,850	396
Other...do	243,354	828	190,320	689
Mineral-earth pigments: Iron oxide, natural and manufactured...short tons	3,862	1,113	3,213	855
Nitrogen compounds (major)...do	623,370	33,063	445,930	30,480
Phosphate rock...long tons	[1] 4,250,970	[1] 37,584	4,122,732	36,910
Phosphatic fertilizers (superphosphates) long tons	416,931	19,882	469,197	23,695
Pigments and salts (lead and zinc):				
Lead pigments...short tons	2,118	705	2,302	764
Zinc pigments...do	2,327	694	2,791	759
Lead salts...do	944	355	464	183

See footnotes at end of table.

TABLE 9.—U.S. exports of principal minerals and products—Continued

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Potash:				
Fertilizer do	815,521	$23,508	776,827	$29,673
Chemical do	17,372	2,418	29,740	2,995
Quartz crystal (raw)	(2)	354	(2)	518
Radioactive isotopes, etc curie	146,983	1,286	202,769	1,741
Salt:				
Crude and refined short tons	[1] 420,322	2,548	641,966	3,876
Shipments to noncontiguous Territories short tons	14,311	1,042	10,164	793
Sodium and sodium compounds:				
Sodium sulfate do	30,724	940	32,259	992
Sodium carbonate thousand short tons	155	5,143	132	4,045
Stone:				
Limestone, crushed, ground, broken short tons	[1] 926,197	[1] 1,780	790,912	1,596
Marble and other building and monumental cubic feet	431,262	1,250	435,173	1,596
Stone, crushed, ground, broken short tons	153,106	2,659	128,149	3,027
Manufactures of stone	(2)	477	(2)	430
Sulfur:				
Crude long tons	1,775,526	40,880	1,585,531	35,370
Crushed, ground, flowers of do	11,017	1,413	10,512	1,254
Talc:				
Crude and ground short tons	59,457	1,801	47,912	1,721
Manufactures, n.e.c do	158	92	134	84
Powders-talcum (face and compact)	(2)	1,378	(2)	1,396
Fuels:				
Carbon black thousand pounds	[1] 543,047	[1] 49,602	522,331	48,166
Coal:				
Anthracite short tons	[1] 1,440,400	[1] 22,903	1,546,488	22,354
Bituminous do	[1] 36,541,075	[1] 331,616	34,969,825	319,034
Briquets do	21,126	305	12,731	176
Coke do	353,016	6,885	445,232	8,213
Petroleum:				
Crude thousand barrels	3,087	8,032	3,219	8,541
Gasoline [4] do	12,380	82,615	8,209	56,481
Kerosine do	590	3,148	210	1,462
Distillate oil do	[1] 9,843	[1] 35,348	6,838	23,594
Residual oil do	18,695	43,412	14,023	34,575
Lubricating oil do	[1] 15,314	207,200	16,607	218,388
Asphalt do	[1] 788	4,501	510	3,928
Liquefied petroleum gases do	2,989	9,646	3,549	13,322
Wax do	1,334	26,445	1,238	24,694
Coke do	6,858	27,009	7,271	29,234
Petroleum do	258	6,182	246	6,098
Miscellaneous do	500	14,719	476	14,292

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[1] Revised figure.
[2] Weight not recorded.
[3] Adjusted by Bureau of Mines.
[4] Includes naphtha, but excludes benzol: 1960—561,193 barrels ($8,951,625); 1961—1,106,390 barrels ($16,877,309).

Compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign Activities, Bureau of Mines, from records of the U.S. Department of Commerce, Bureau of the Census.

TABLE 10.—Comparison of world and United States production of principal metals and minerals

Mineral	1960			1961		
	World	United States		World	United States	
	Thousand short tons (unless otherwise stated)		Percent of world	Thousand short tons (unless otherwise stated)		Percent of world
Fuels:						
Coal:						
Bituminous	2,007,957	412,766	21	1,962,276	399,959	20
Lignite	706,214	2,746	(1)	727,262	3,018	(1)
Pennsylvania anthracite	192,300	18,817	10	190,800	17,446	9
Coke (excluding breeze):						
Gashouse [2]	51,300	(3)	(3)	50,430	(3)	(3)
Oven and beehive	308,209	57,229	19	305,961	51,711	17
Fuel briquets and packaged fuel	118,700	769	(1)	121,300	591	(1)
Natural gas (marketable) million cubic feet	(4)	12,771,038	(4)	(4)	(4)	(4)
Peat	68,500	471	(1)	69,700	525	(1)
Petroleum (crude) thousand barrels	7,674,493	2,574,933	34	8,187,986	2,621,758	32
Nonmetals:						
Asbestos	2,440	45	2	2,770	53	2
Barite	3,100	771	25	3,000	731	24
Cement [5] thousand barrels	1,866,277	334,130	18	1,997,319	338,628	17
Corundum	9	----------	--------	8	----------	--------
Diamonds thousand carats	27,700	----------	--------	33,700	----------	--------
Diatomite	1,000	450	45	1,030	450	44
Feldspar thousand long tons	1,470	502	34	1,500	497	33
Fluorspar	2,190	230	11	2,300	205	9
Graphite	465	(3)	(3)	450	(3)	(3)
Gypsum	43,200	9,825	23	43,035	9,500	22
Magnesite	7,200	499	7	8,600	604	7
Mica (including scrap) thousand pounds	365,000	196,395	54	355,000	198,568	56
Nitrogen, agricultural [5] [6]	10,800	2,804	26	11,570	2,954	26
Phosphate rock thousand long tons	40,870	17,516	43	43,770	18,559	42
Potash (K_2O equivalent)	10,000	2,639	26	10,500	2,733	26
Pumice [7]	11,900	2,210	19	13,400	2,463	18
Pyrites thousand long tons	19,300	1,016	5	19,400	987	5
Salt [5]	93,900	25,481	27	96,400	25,707	27
Strontium [7]	13	----------	--------	11	----------	--------
Sulfur, elemental thousand long tons	10,290	5,804	56	11,380	6,333	56
Talc, pyrophyllite, and soapstone	2,750	734	27	2,890	761	26
Vermiculite [7]	269	199	74	279	207	74
Metals, mine basis:						
Antimony (content of ore and concentrate) short tons	61,000	637	1	60,000	689	1
Arsenic, white [7]	57	(3)	(3)	59	(3)	(3)
Bauxite thousand long tons	26,980	1,998	7	29,040	1,228	4
Beryllium concentrate short tons	9,300	509	5	8,600	1,122	13
Bismuth thousand pounds	5,300	(3)	(3)	5,500	(3)	(3)
Cadmium do	22,100	10,180	46	20,100	9,943	49
Chromite	4,930	[8] 107	2	4,655	[8] 82	2
Cobalt (contained)[7] short tons	16,800	(3)	(3)	16,100	(3)	(3)
Columbium-tantalum concentrate [7] thousand pounds	6,850	----------	--------	7,370	----------	--------
Copper (content of ore and concentrate)	4,640	1,080	23	4,850	1,165	24
Gold thousand troy ounces	45,400	1,680	4	47,700	1,567	3
Iron ore thousand long tons	512,329	88,784	17	497,610	71,329	14
Lead (content of ore and concentrate)	2,610	247	9	2,660	262	10
Manganese ore (35 percent or more Mn)	15,006	80	(1)	14,933	46	(1)
Mercury thousand 76-pound flasks	242	33	14	240	32	13
Molybdenum (content of ore and concentrate) thousand pounds	89,500	68,237	76	87,900	66,563	76
Nickel (content of ore and concentrate)	359	13	4	396	11	3
Platinum groups (Pt, Pd, etc.) thousand troy ounces	1,250	24	2	1,190	43	4
Silver do	240,200	36,800	15	231,800	34,900	15
Tin (content of ore and concentrate) long tons	181,500	10	(1)	188,000	(3)	(3)
Titanium concentrate:						
Ilmenite [7]	2,205	786	36	2,313	782	34
Rutile [7]	114	9	8	128	9	7
Tungsten concentrate (60 percent WO_3) short tons	69,400	7,325	11	74,200	8,245	11
Vanadium (content of ore and concentrate)[7] short tons	7,090	4,971	70	8,650	5,343	62
Zinc (content of ore and concentrate)	3,590	435	12	3,720	464	12

See footnotes at end of table.

TABLE 10.—Comparison of world and United States production of principal metals and minerals—Continued

Mineral	1960			1961		
	World	United States		World	United States	
	Thousand short tons (unless otherwise stated)		Percent of world	Thousand short tons (unless otherwise stated)		Percent of world
Metals, mine basis—Continued						
Metals, smelter basis:						
Aluminum	4,985	2,014	40	5,195	1,904	37
Copper	4,950	1,234	25	5,060	1,207	24
Iron, pig (incl. ferroalloys)	285,000	68,620	24	289,350	66,717	23
Lead	2,550	382	15	2,660	450	17
Magnesium........short tons	102,600	40,070	39	115,400	40,745	35
Selenium [7]........thousand pounds	1,667	539	32	2,056	1,022	50
Steel ingots and castings	381,400	99,282	26	392,400	98,014	25
Tellurium [7]........thousand pounds	389	271	70	394	205	52
Tin........thousand long tons	192	[9] 14	7	190	[9] 9	5
Uranium oxide (U_3O_8)[7]........short tons	40,740	17,760	44	35,850	17,399	49
Zinc	3,280	800	24	3,550	847	24

[1] Less than 1 percent.
[2] Includes low- and medium-temperature and gashouse coke.
[3] Bureau of Mines not at liberty to publish U.S. figure separately.
[4] Data not available.
[5] Including Puerto Rico.
[6] Year ended June 30 of year stated (United Nations).
[7] World total exclusive of U.S.S.R.
[8] Produced for Federal Government only; excludes quantity consumed by American Chrome Co.
[9] U.S. imports of tin concentrates (tin content).

Compiled by Augusta W. Jann, Division of Foreign Activities.

Employment and Injuries in the Mineral Industries

By John C. Machisak[1]

⁂

THIS CHAPTER of the Minerals Yearbook (Volume III) contains overall injury experience for coal mines, both anthracite and bituminous, coke plants, petroleum and natural gas, peat, and asphalt and related bitumens (native); metal mines, their metallurgical plants, including ore-dressing plants and primary nonferrous reduction plants and refineries; nonmetal mines; nonmetal mills; sand and gravel operations; slag (iron blast-furnace) plants; and stone quarries and their related plants. Volume I of the yearbook contains a chapter showing injury experience and employment data treated separately by metal mines, nonmetal mines, quarries and their related plants, metallurgical plants (ore-dressing plants and primary nonferrous reduction plants and refineries are shown separately), nonmetal mills, sand and gravel plants, and iron blast-furnace slag plants. Volume II contains injury and employment experience in the fuel industries (coal, coke, petroleum and natural gas, asphalt and related bitumens (native), and peat. Injury and employment data are submitted voluntarily for the mineral operations through an industry canvass made by the Bureau of Mines, except for the coal industry, whose reports are mandatory. Information published in this chapter is the result of this canvass.

Figures presented in this chapter for 1961 are preliminary except for anthracite, peat, coke, petroleum and natural gas, asphalt and related bitumens, and slag. These preliminary data, with the exception of bituminous coal, are a summation of reports received by May 31, 1962, from the operators showing their injury and employment experience. Estimations of injury and employment experience are not included in these preliminary data.

The safety record of the mineral industries for 1961 was not as favorable as that of 1960, measured by the combined (fatal and nonfatal) injury-frequency rate per million man-hours of worktime based on preliminary data that revealed an increase of 2 percent. The mines and plants averaged 252 active days; employees averaged 2,022 hours of work each, an increase of 1 percent over the average of 1,993 hours in 1960.

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[1] Chief, Branch of Accident Analysis, Division of Accident Prevention and Health.

One major disaster (a single accident in which five or more men are killed) occurred in a bituminous coal mine in Indiana on March 2, 1961. It was caused by a gas explosion which killed 22 men.

Work Stoppages.—Work stoppages reported by the U.S. Department of Labor, Bureau of Labor Statistics, numbered 167, totaling 619,000 man-days of work lost—an increase over 1960 of 6 percent in work stoppages and a decrease of 18 percent in man-days lost. The bituminous coal mining industry had 117 work stoppages in 1961; anthracite had 5. Days lost were approximately 91,000 and 4,000, respectively. The petroleum refining industry had nine stoppages and 310,000 man-days lost during the year; the crushed and broken stone industry reported seven stoppages and approximately 3,000 days lost; hydraulic cement reported five stoppages and nearly 5,000 man-days of work lost. In the metal mining industry, copper and lead-zinc each reported four stoppages with 106,000 and 18,000 man-days lost, respectively. The sand and gravel industry with four work stoppages, reported slightly more than 4,000 man-days lost in 1961. Of the remaining 12 stoppages, 6 occurred in the mining and quarrying of nonmetallic minerals (except fuels)—chemical and fertilizer mineral mining, 3; clay, 2; and dimension stone, 1. The remainder were in the metal mining industry, iron, two; miscellaneous metal ores, two; gold-silver, one; and ferroalloy metal ores, one. These 12 industry work stoppages accounted for the loss of 100,000 man-days—78,000 at metal mines and 22,000 at nonmetallic mines.

TABLE 1.—Salient statistics of injury experience and employment data in the mineral industries of the United States, by industry groups

	1957	1958	1959	1960	1961 [1]
Average number of men working daily: [2]					
Coal mines	254,725	224,890	203,597	189,679	158,092
Coke plants	20,264	16,186	16,645	16,463	13,534
Petroleum and natural gas [3]	617,596	584,708	559,244	511,107	452,721
Peat [4]	139	464	467	576	765
Asphalt and related bitumens (nat.) [5]	------------	------------	------------	445	383
Metal mines	68,457	59,608	58,557	60,595	48,044
Nonmetal mines (except stone quarries)	17,921	17,820	18,765	18,653	14,645
Sand and gravel operations [4]	31,531	51,122	59,492	52,352	29,203
Stone quarries	84,126	88,448	91,523	95,304	66,681
Slag (iron blast-furnace) [6]	------------	1,882	1,789	1,680	1,682
Metallurgical plants	65,212	52,109	55,655	58,689	45,786
Nonmetal mills	27,081	32,401	40,800	39,568	30,558
Total	1,187,052	1,129,638	1,106,534	1,045,111	862,094
Average number of active mine days:					
Coal mines	204	183	186	189	196
Coke plants	355	351	328	350	354
Petroleum and natural gas [3]	262	260	(7)	(7)	(7)
Peat [4]	209	171	178	169	156
Asphalt and related bitumens (nat.) [5]	------------	------------	------------	264	256
Metal mines	259	229	214	246	249
Nonmetal mines (except stone quarries)	262	239	239	242	257
Sand and gravel operations [4]	221	211	(7)	(7)	217
Stone quarries	266	264	(7)	(7)	261
Slag (iron blast-furnace) [6]	------------	248	254	(7)	246
Metallurgical plants	322	302	289	309	311
Nonmetal mills	274	272	274	270	268
Total	254	244	213	213	252
Man-days worked, in thousands:					
Coal mines	52,077	41,121	37,773	35,778	30,912
Coke plants	7,187	5,683	5,467	5,768	4,791
Petroleum and natural gas [3]	161,716	151,965	148,143	132,917	118,968
Peat [4]	29	79	83	97	120
Asphalt and related bitumens (nat.) [5]	------------	------------	------------	117	98
Metal mines	17,751	13,665	12,503	14,910	11,980
Nonmetal mines (except stone quarries)	4,691	4,258	4,488	4,515	3,758
Sand and gravel operations [4]	6,954	10,763	(7)	(7)	6,347
Stone quarries	22,410	23,353	(7)	(7)	17,434
Slag (iron blast-furnace) [6]	------------	467	455	(7)	415
Metallurgical plants	21,003	15,733	16,095	18,149	14,253
Nonmetal mills	7,415	8,809	11,195	10,679	8,196
Total [8]	301,232	275,895	236,203	222,930	217,271
Man-hours worked, in thousands:					
Coal mines	408,207	322,229	296,031	281,528	243,244
Coke plants	57,337	45,486	43,626	46,066	38,306
Petroleum and natural gas [3]	1,293,725	1,215,722	1,185,146	1,063,332	951,743
Peat [4]	231	704	738	866	1,038
Asphalt and related bitumens (nat.) [5]	------------	------------	------------	948	792
Metal mines	142,181	109,523	100,576	119,653	97,515
Nonmetal mines (except stone quarries)	37,877	34,648	36,334	36,805	30,766
Sand and gravel operations [4]	59,764	92,456	109,830	95,749	53,959
Stone quarries	183,394	186,821	199,321	202,366	142,580
Slag (iron blast-furnace) [6]	------------	3,776	3,681	3,613	3,361
Metallurgical plants	167,489	125,773	128,913	145,210	114,073
Nonmetal mills	59,765	71,161	90,706	86,386	65,719
Total [8]	2,409,970	2,208,298	2,194,902	2,082,521	1,743,095

See footnotes at end of table.

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TABLE 1.—Salient statistics of injury experience and employment data in the mineral industries of the United States, by industry groups—Continued

	1957	1958	1959	1960	1961[1]
Number of injuries:					
Fatal:					
Coal mines	478	358	293	325	294
Coke plants	12	5	3	3	3
Petroleum and natural gas [3, 9]	121	116	120	82	111
Peat [4]	-----	-----	1	-----	-----
Asphalt and related bitumens (nat.) [5]	-----	-----	-----	1	1
Metal mines	71	70	73	84	41
Nonmetal mines (except stone quarries)	9	15	11	19	11
Sand and gravel operations [4]	35	25	21	25	21
Stone quarries	53	45	52	39	29
Slag (iron blast-furnace) [6]	-----	1	1	-----	-----
Metallurgical plants	21	12	11	12	8
Nonmetal mills	10	9	11	13	6
Total	810	656	597	603	525
Nonfatal:					
Coal mines	18,792	14,160	12,163	11,902	11,210
Coke plants	244	210	222	223	193
Petroleum and natural gas [3, 9]	11,426	11,588	10,543	9,110	8,697
Peat [4]	5	12	14	24	17
Asphalt and related bitumens (nat.) [5]	-----	-----	-----	38	30
Metal mines	4,554	3,499	3,281	3,794	3,251
Nonmetal mines (except stone quarries)	1,112	955	1,072	1,056	688
Sand and gravel operations [4]	1,763	1,698	2,161	1,919	951
Stone quarries	4,210	4,572	4,790	4,668	2,972
Slag (iron blast-furnace) [6]	-----	43	43	34	30
Metallurgical plants	2,280	1,698	1,305	1,482	1,384
Nonmetal mills	1,512	1,490	2,156	1,794	1,378
Total	45,898	39,925	37,750	36,044	30,801
Injury rates per million man-hours:					
Fatal:					
Coal mines	1.17	1.11	0.99	1.15	1.21
Coke plants	.21	.11	.07	.07	.08
Petroleum and natural gas [3, 9]	.09	.10	.10	.08	.12
Peat [4]	-----	-----	1.36	-----	-----
Asphalt and related bitumens (nat.) [5]	-----	-----	-----	1.06	1.26
Metal mines	.50	.64	.73	.70	.42
Nonmetal mines (except stone quarries)	.24	.43	.30	.52	.36
Sand and gravel operations [4]	.59	.27	.19	.26	.39
Stone quarries	.29	.24	.26	.19	.20
Slag (iron blast-furnace) [6]	-----	.26	.27	-----	-----
Metallurgical plants	.13	.10	.09	.08	.07
Nonmetal mills	.17	.13	.12	.15	.09
Total	.34	.30	.27	.29	.30
Nonfatal:					
Coal mines	46.04	43.94	41.09	42.28	46.09
Coke plants	4.26	4.62	5.09	4.84	5.04
Petroleum and natural gas [3, 9]	8.83	9.53	8.90	8.57	9.14
Peat [4]	21.68	17.05	18.97	27.72	16.38
Asphalt and related bitumens (nat.) [5]	-----	-----	-----	40.10	37.90
Metal mines	32.03	31.95	32.62	31.71	33.34
Nonmetal mines (except stone quarries)	29.36	27.56	29.50	28.69	22.36
Sand and gravel operations [4]	29.50	18.37	19.68	20.04	17.62
Stone quarries	22.96	24.47	24.03	23.07	20.84
Slag (iron blast-furnace) [6]	-----	11.39	11.68	9.41	8.93
Metallurgical plants	13.61	13.50	10.12	10.21	12.13
Nonmetal mills	25.30	20.94	23.77	20.77	20.97
Total	19.05	18.08	17.20	17.31	17.67

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[1] Preliminary figures, except anthracite, coke, petroleum and natural gas, peat, native asphalt, and slag.
[2] Men at work each day mine was active.
[3] Includes officeworkers, as separate data not available.
[4] Peat and sand and gravel canvasses included beginning 1957.
[5] Asphalt and related bitumens (nat.) canvass shown separately and included with fuels beginning 1960, formerly included with nonmetals.
[6] Slag (iron blast-furnace) canvass included beginning 1958.
[7] Data not available.
[8] Data will not necessarily add to total due to rounding.
[9] Permanent total injuries are combined with fatalities.

TABLE 2.—Work stoppages in certain mineral industries in the United States

Industry and year	Work stoppages	
	Number	Man-days lost (thousands)
Coal mining:		
Anthracite:		
1957	3	2.6
1958	8	2.1
1959	1	1.2
1960	6	9.3
1961	5	4.2
Bituminous:		
1957	161	136.0
1958	136	102.0
1959	146	[1] 1,560.0
1960	120	[1] 137.0
1961	117	90.7
Coke and byproducts:		
Coke only:		
1957	5	25.1
1958	(2)	(2)
1959	(2)	(2)
1960	(2)	(2)
1961	(2)	(2)
Petroleum refining:		
1957	9	200.0
1958	8	124.0
1959	13	543.0
1960	2	[1] 48.2
1961	9	310.0
Metal mining:		
Iron:		
1957	4	18.6
1958	1	9.7
1959	8	2,120.0
1960	2	15.2
1961	2	4.2
Copper:		
1957	3	31.5
1958	2	22.0
1959	9	1,800.0
1960	1	[1] 361.0
1961	4	106.0
Lead-zinc:		
1957	5	7.1
1958	----------	----------
1959	5	28.0
1960	3	58.8
1961	4	18.0
Gold-silver:		
1957	1	[3] 1.5
1958	----------	----------
1959	----------	----------
1960	----------	----------
1961	1	2.1
Bauxite and other aluminum ores:		
1957	----------	----------
1958	----------	----------
1959	----------	----------
1960	----------	----------
1961	----------	----------
Ferroalloy metal ores:		
1957	----------	----------
1958	2	84.2
1959	1	(4)
1960	1	(4)
1961	1	5.5
Metal mining services:		
1957	----------	----------
1958	----------	----------
1959	1	(4)
1960	----------	----------
1961	----------	----------
Metal mining—Continued		
Miscellaneous metal ores:		
1957	1	2.0
1958	2	1.5
1959	2	2.0
1960	2	2.3
1961	2	44.4
Mining and quarrying of nonmetallic minerals (except fuels):		
Dimension stone:		
1957	3	18.0
1958	2	14.3
1959	----------	----------
1960	1	2.5
1961	1	2.6
Crushed and broken stone:		
1957	4	8.2
1958	7	5.7
1959	8	76.9
1960	13	104.0
1961	7	2.8
Sand and gravel:		
1957	2	(4)
1958	2	25.2
1959	3	[1] 11.1
1960	3	1.8
1961	4	4.3
Clay, ceramic and refractory minerals:		
1957	1	(4)
1958	(1)	(4)
1959	2	1.2
1960	----------	----------
1961	2	1.9
Chemical and fertilizer mineral mining:		
1957	4	4.6
1958	5	32.5
1959	3	45.5
1960	2	7.3
1961	3	17.6
Nonmetallic minerals (except fuels) services:		
1957	1	1.1
1958	----------	----------
1959	----------	----------
1960	----------	----------
1961	----------	----------
Miscellaneous nonmetallic minerals (except fuels):		
1957	----------	----------
1958	1	2.5
1959	----------	----------
1960	----------	----------
1961	----------	----------
Cement, hydraulic:		
1957	6	436.0
1958	6	38.6
1959	8	74.8
1960	2	[1] 3.6
1961	5	4.9

[1] Includes idleness from stoppages which began in previous year.
[2] Data not available.
[3] Includes some lead, copper, zinc, and silver.
[4] Less than 1,000 man-days.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

NATIONAL SAFETY COMPETITION

The National Safety Competitions, sponsored and conducted annually by the Bureau of Mines, stimulated great interest among the Nation's mineral-extractive industries and, by according national recognition to operations achieving outstanding safety records, encouraged development of more effective accident-prevention programs. Of the 1,519 operations participating in the 1961 competitions, 790 (52 percent) were injury-free—the greatest number in any single year. These 790 injury-free operations worked almost 44 million man-hours (24 percent) of the total exposure to occupational hazards.

Of the five competitions conducted by the Bureau of Mines, two were sponsored solely by the Bureau. They were the National Safety and the National Sand and Gravel Competitions. In these two contests, 627 operations (52 percent) finished the 1961 competition year free of disabling work injuries. These 627 operations accounted for 33,105,271 man-hours (22 percent) of the total man-hours worked (149,925,244) by all the participating operations.

In addition, the Bureau of Mines conducted three other annual competitions, cosponsored by national associations connected with the mineral industries—the National Crushed Stone Association, National Lime Association, and National Slag Association. During 1961, 322 plants participated in the association-sponsored contests, of which 163 (51 percent) attained injury-free records during an aggregate worktime of more than 10 million man-hours. These injury-free man-hours accounted for 37 percent of the total man-hours worked by all plants participating in these competitions.

Trophy awards for the best safety records in each of the six groups in the 1961 National Safety Competition were made to the following:

Anthracite Underground Mines.—Newkirk Tunnel mine of Newkirk Mining Co., Tamaqua, Pa.

Bituminous Coal Underground Mines.—Maple Creek mine of United States Steel Corp., New Eagle, Pa.

Metal Underground Mines.—Pioneer mine of Oliver Iron Mining Division, United States Steel Corp., Ely, Minn.

Nonmetal Underground Mines.—Bellefonte mine of National Gypsum Co., Bellefonte, Pa.

Open-Pit Mines.—Iron Mountain and Desert Mountain mines of Columbia Iron Mining Co., United States Steel Corp., Cedar City, Utah.

Quarries.—Calcite quarry of Michigan Limestone Division, United States Steel Corp., Rogers City, Mich.

TABLE 3.—Employment and injury experience in the mineral industries

Year	Men working	Man-hours worked	Number of injuries		Injury rate per million man-hours	
			Fatal	Nonfatal	Fatal	Nonfatal
1931	784, 347	1, 288, 135, 808	1, 707	94, 021	1. 33	72. 99
1932	671, 343	962, 924, 915	1, 368	66, 028	1. 42	68. 57
1933	677, 722	1, 058, 245, 650	1, 242	70, 158	1. 17	66. 30
1934	739, 817	1, 167, 723, 543	1, 429	79, 211	1. 22	67. 83
1935	783, 139	1, 215, 316, 764	1, 495	80, 070	1. 23	65. 88
1936	824, 514	1, 426, 233, 543	1, 686	90, 608	1. 18	63. 53
1937	859, 951	1, 482, 241, 908	1, 759	94, 466	1. 19	63. 73
1938	774, 894	1, 144, 137, 296	1, 369	69, 940	1. 20	61. 13
1939	788, 925	1, 251, 169, 210	1, 334	73, 253	1. 07	58. 55
1940	801, 926	1, 385, 128, 234	1, 716	80, 856	1. 24	58. 37
1941	835, 095	1, 541, 335, 277	1, 621	87, 911	1. 05	57. 04
1942 [1]	1, 120, 450	2, 319, 213, 897	1, 970	100, 861	. 85	43. 49
1943	1, 144, 831	2, 555, 619, 729	1, 953	101, 164	. 76	39. 58
1944	1, 086, 103	2, 573, 452, 816	1, 751	98, 066	. 68	38. 11
1945	1, 033, 035	2, 363, 783, 323	1, 414	87, 578	. 60	37. 05
1946	1, 108, 517	2, 275, 960, 528	1, 336	86, 291	. 59	37. 91
1947	1, 179, 835	2, 469, 256, 565	1, 556	91, 311	. 63	36. 98
1948	1, 242, 241	2, 530, 418, 226	1, 383	86, 295	. 55	34. 10
1949	1, 240, 330	2, 256, 418, 166	898	65, 909	. 40	29. 21
1950	1, 237, 649	2, 340, 954, 733	952	66, 729	. 41	28. 51
1951	1, 223, 639	2, 418, 090, 394	1, 122	67, 285	. 46	27. 83
1952	1, 230, 692	2, 383, 608, 034	927	61, 296	. 39	25. 72
1953	1, 193, 182	2, 357, 970, 591	817	53, 992	. 35	22. 90
1954	1, 096, 423	2, 138, 687, 112	671	43, 130	. 31	20. 17
1955 [2]	1, 122, 393	2, 290, 057, 680	729	46, 197	. 32	20. 17
1956 [3]	1, 113, 471	2, 294, 678, 414	788	45, 454	. 34	19. 81
1957 [4]	1, 187, 052	2, 409, 969, 589	810	45, 898	. 34	19. 05
1958 [5]	1, 129, 638	2, 208, 298, 487	656	39, 925	. 30	18. 08
1959 [6]	1, 106, 534	2, 194, 901, 514	597	37, 750	. 27	17. 20
1960	1, 045, 111	2, 082, 521, 189	603	36, 044	. 29	17. 31
1961 [7]	862, 094	1, 743, 095, 230	525	30, 801	. 30	17. 67

[1] Includes oil and gas beginning with 1942.
[2] Clay mines and nonmetal mills included beginning with 1955.
[3] Clay mills included beginning with 1956.
[4] Peat and sand and gravel included beginning with 1957.
[5] Slag included beginning with 1958.
[6] Revised.
[7] Preliminary figures.

The Mineral Industry of Alabama

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Alabama.

By Avery H. Reed, Jr.,[1] and Thomas A. Simpson[2]

❖

RECORD production of crushed limestone, sand and gravel, lime, dimension marble, scrap mica, and kaolin highlighted the mineral industry of Alabama in 1961. Among the States, Alabama ranked third in the production of bauxite, native asphalt, and scrap mica, and fifth in iron ore.

The mineral industry in Alabama was dominated by mining and processing of coal and iron ore, and the manufacture of cement, which together furnished 73 percent of the total value of production, the same as in 1960. Other important industries were the production of crude petroleum, and stone quarrying. Leading companies were Tennessee Coal & Iron, Southern Cement Co., Alabama By-Products Corp., Woodward Iron Co., Southeastern Electric Generating Co., and Alabama Power Co.

TABLE 1.—Mineral production in Alabama[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry____________thousand 280-pound barrels__	2,117	$6.564	2,006	$6,156
Portland____________thousand 376-pound barrels__	11,355	36,142	12,445	39,027
Clays[2]________________________thousand short tons__	1,840	2,170	1,787	2,068
Coal (bituminous)______________________________do____	13,011	92,439	12,915	90,903
Iron ore (usable)___thousand long tons, gross weight__	4,068	23,511	3,597	20,510
Lime__________________________thousand short tons__	[6] 536	[6] 6,593	579	6,871
Natural gas______________________million cubic feet__	57	4	56	4
Petroleum (crude)_______thousand 42-gallon barrels__	7,329	(3)	[4] 6,932	[4] 19,063
Sand and gravel_________________thousand short tons__	4,359	4,759	5,800	6,452
Stone[5]______________________________________do____	13,503	19,790	13,651	19,909
Value of items that cannot be disclosed: Asphalt (native), bauxite, slag cement, clay (kaolin), mica, salt, stone (dimension limestone and marble, oystershell, and crushed sandstone), talc, and values indicated by footnote 3____	___________	[6] 29,650	___________	7,919
Total Alabama[7]______________________________	___________	[6] 217,507	___________	214,411

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes kaolin; included with "Value of items that cannot be disclosed."
[3] Figure withheld to avoid disclosing individual company confidential data.
[4] Preliminary figure.
[5] Excludes certain stone; included with "Value of items that cannot be disclosed."
[6] Revised figure.
[7] Total adjusted to eliminate duplicating value of clays and stone.

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Total value of mineral production was 1 percent below the 1960 record. Substantial decreases in values for coal and iron ore were nearly offset by increased values for cement and sand and gravel.

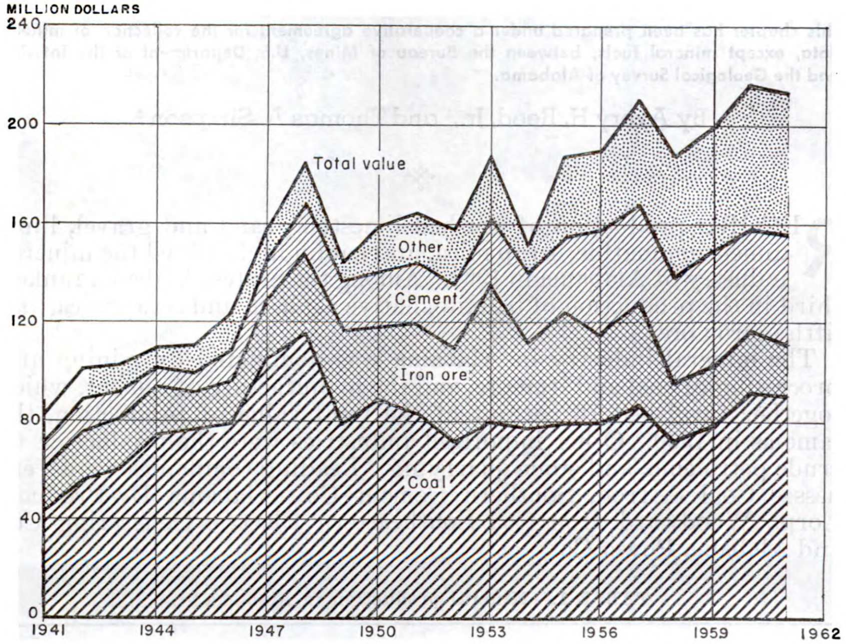

FIGURE 1.—Value of coal, iron ore, cement, and total value of mineral production in Alabama, 1941–61.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operations	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:							
Coal mines[1]	203	7,400	200	11,851,822	11	154	14
Quarries and mills	55	2,968	294	6,960,601	2	75	11
Coke ovens	7	1,537	363	4,470,073	1	34	8
Metal mines	39	2,711	210	4,535,944	2	30	7
Nonmetal mines	33	879	240	1,690,047	----------	37	22
Sand and gravel mines	36	533	270	1,141,455	2	31	29
Total	373	16,028	239	30,649,942	18	361	12
1961:[2]							
Coal mines[1]	201	6,765	195	10,530,702	10	129	13
Quarries and mills	56	2,947	280	6,592,664	----------	59	9
Coke ovens and smelters	8	1,877	362	5,430,319	----------	28	5
Metal mines	37	2,222	209	3,709,175	----------	22	6
Nonmetal mines	35	1,047	249	2,083,905	----------	44	21
Sand and gravel mines	42	640	271	1,387,478	----------	29	21
Total	379	15,498	240	29,734,243	10	311	11

[1] Excludes officeworkers.
[2] Preliminary figures.

Employment and Injuries.—Total employment in the mineral industries was 3 percent less than in 1960, owing mainly to decreases of 11 percent in employment at coal mines and 18 percent at metal mines. Increased employment was recorded for nonmetal mines and for sand and gravel mines.

Injury-frequency rate improved to a record low of 11 injuries per million man-hours. Improved frequency rates were recorded for all industries. There were 10 fatalities, all at coal mines, compared with 18 fatalities in 1960.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Asphalt (Native).—Alabama Asphaltic Limestone Co. (Margerum quarry) crushed bituminous limestone in Colbert County for roadstone; production increased 17 percent. Among the States, Alabama ranked third in the production of native asphalt.

Coal (Bituminous).—Bituminous coal was mined at 193 mines in 10 counties, compared with 177 mines in 10 counties in 1960. Leading counties were Jefferson, Walker, and Tuscaloosa. Leading companies were Tennessee Coal & Iron, Alabama By-Products Corp., Southeastern Electric Generating Co., Alabama Power Co., and Woodward Iron Co., which together supplied 65 percent of the State's total. Production decreased 1 percent compared with 1960 and was 39 percent below the 1926 record. Average output per mine decreased from 73,500 tons in 1960 to 66,900 tons.

Underground mines produced 78 percent of the production; strip mines, 21 percent; and auger mines, 1 percent. Eighty-two percent of the coal was shipped by rail or water; 8 percent, by conveyor belt; and 10 percent, by truck. Coal was loaded by 116 mobile loading machines, 18 continuous mining machines, 4 self-loading conveyors, and 50 face conveyors; 93 percent of coal mined underground was mechanically loaded. Captive tonnage was 58 percent of the total, compared with 45 percent in 1960.

Equipment used at 145 underground mines included 180 cutting machines, which cut 87 percent of the tonnage; 232 power drills, which drilled 94 percent; 265 locomotives; 26 tractors; 228 shuttle cars; and 58 mother conveyors.

Equipment used at 44 strip mines included 77 power shovels, 21 draglines, 7 carryall scrapers, 63 bulldozers, 35 power drills, and 115 trucks. An estimated 50 million cubic yards of overburden was excavated.

Four coal-recovery augers and five trucks were used at four auger mines.

Of the total production of coal, 89 percent was cleaned at 37 cleaning plants.

Coke.—Six companies produced byproduct metallurgical coke at seven plants in Jefferson, Etowah, and Tuscaloosa Counties. Leading coke producers were Tennessee Coal & Iron and U.S. Pipe & Foundry Co.

TABLE 3.—Coal (bituminous) production by counties

County	1960		1961	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Bibb	19,839	$91	40,607	$152
Blount	160,688	996	160,976	841
Cullman	66,936	415	31,132	187
Jackson	8,122	41	16,375	98
Jefferson	7,944,694	60,600	6,946,256	52,738
Marion	208,238	1,240	181,726	821
Shelby	57,546	387	420,942	3,318
Tuscaloosa	701,323	2,988	(1)	(1)
Walker	3,715,407	25,106	(1)	(1)
Winston	127,854	575	108,268	478
Undistributed			5,009,183	32,261
Total	13,010,647	92,439	12,915,465	90,903
Earliest record to date	959,645,000	(2)	972,560,000	(2)

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Data not available.

Natural Gas.—Marketed production of natural gas from Marion County was about the same as in 1960.

Petroleum.—Production of crude petroleum decreased 5 percent below the 1960 record. Leading counties were Mobile and Escambia. During the year, 42 new producing wells were drilled. The 426 producing wells were in the following counties: Baldwin, 6; Choctaw, 70; Clarke, 13; Escambia, 36; and Mobile, 301.

TABLE 4.—Crude petroleum production by counties

(Barrels)

County	1960	1961 [1]
Baldwin	41,188	31,156
Choctaw	302,332	267,956
Clarke	131,320	130,011
Escambia	627,775	629,061
Mobile	6,226,385	5,873,816
Total	7,329,000	6,932,000
Earliest record to date	33,799,000	40,731,000

[1] Preliminary figures.

Source: State Oil & Gas Board.

NONMETALS

Cement.—Seven companies produced masonry cement at eight plants in four counties. Leading producers were Southern Cement Co. and National Cement Co. Shipments decreased 5 percent and were 23 percent below the 1955 record. Consumption of masonry cement in Alabama was 21 percent of shipments. Out-of-State shipments were made to Georgia (33 percent), South Carolina (11 percent), North Carolina (8 percent), Florida (7 percent), Louisiana (7 percent), Mississippi (7 percent), Tennessee (4 percent), and other States (2 percent).

Seven companies produced portland cement at eight plants in five counties. Leading producers were Ideal Cement Co. (Mobile plant) and Southern Cement Co. (Calera plant). Shipments increased 10 percent but were 4 percent below the 1959 record. Consumption of portland cement in Alabama was 39 percent of shipments. Out-of-State shipments were made to Georgia (18 percent), Florida (15 percent), Mississippi (12 percent), South Carolina (6 percent), North Carolina (4 percent), Tennessee (3 percent), and other States (3 percent). Raw materials used in manufacturing portland cement comprised limestone and oystershell (47 percent), cement rock (33 percent), clay and shale (13 percent), and other materials (7 percent).

End uses of portland cement were as follows: Ready-mixed concrete (46 percent), concrete-products manufacturers (21 percent), highway contractors (16 percent), building-materials dealers (9 percent), and other uses (2 percent). Annual capacity of portland cement plants was 16,340,000 barrels.

Southern Cement Co. and Cheney Lime & Cement Co. produced slag cement. Shipments were 16 percent below 1960 and 78 percent below the 1952 record.

Clays.—Twenty-one companies mined 1,517,000 tons of miscellaneous clay at 23 mines in 12 counties for portland cement and heavy clay products. Leading producers were Southern Cement Co. and Jenkins Brick Co. Production decreased 2 percent below the 1960 record.

Twelve companies mined fire clay at 13 mines in 7 counties. Leading producers were Donoho Clay Co. and Russell Coal & Clay Co. Production decreased 7 percent and was 11 percent below the 1956 record.

Harbison-Walker Refractories Co. and Thomas Alabama Kaolin Co. mined kaolin in Barber and Marion Counties. Production increased 11 percent above the 1960 record.

TABLE 5.—Fire clay sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Firebrick and block	105,602	$278,755	$2.64	91,825	$241,217	$2.63
Foundries and steelworks	35,477	79,804	2.25	26,154	68,850	2.63
Fire-clay mortar	(1)	(1)	(1)	7.271	14,184	1.95
Other	[2] 150,165	[2] 394,812	[2] 2.63	[3] 145,063	[3] 375,712	[3] 2.59
Total	291,244	753,371	2.59	270,313	699,963	2.59

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes saggers, pins, stilts, and wads, heavy clay products, clay crucibles, bauxite high-alumina brick, other refractories, and uses indicated by footnote 1.

[3] Includes saggers, pins, stilts, and wads, heavy clay products, and bauxite high-alumina brick.

Lime.—Seven companies produced quicklime and hydrated lime at eight plants in Dallas, Jefferson, and Shelby Counties for building, agricultural, refractory, chemical, and industrial uses. Leading producers were Southern Cement Co. (Roberta and Keystone limekilns) and Longview Lime Corp. Production increased 8 percent compared with 1960 and was about the same as in 1959, the previous record year. Consumption of lime in Alabama amounted to 59 percent of shipments. Out-of-State shipments were made to Florida (17 percent), Georgia (11 percent), Tennessee (4 percent), Mississippi (4 percent), and other States (5 percent).

TABLE 6.—Lime sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Chemical and industrial	404,747	$4,903,236	$12.06	478,659	$5,496,500	$11.48
Other [1]	131,336	1,690,170	12.87	100,652	1,374,059	13.65
Total	536,083	6,593,406	12.25	579,311	6,870,559	11.86

[1] Includes construction, refractory, and agricultural lime.

Magnesium Compounds.—Tennessee Coal & Iron produced dead-burned dolomite for refractory use.

Mica.—Dixie Mines, Inc., mined scrap mica at the Dixie mine; production increased 12 percent over the 1960 record. J. J. New and Dixie Mines, Inc., mined a small quantity of sheet mica. Among the States, Alabama ranked third in scrap mica production.

Salt.—Olin Mathieson Chemical Corp. produced salt from brine in Washington County; output was 9 percent below the 1960 record.

Sand and Gravel.—Twenty-five companies mined sand and gravel at 30 mines in 21 counties. Leading producers were Alabama Gravel Co., Southeastern Sand & Gravel Co., and Birmingham Slag Co. Leading counties were Montgomery, Mobile, and Elmore. Production increased 33 percent and was 15 percent above the 1957 record. Of the total production, 85 percent was processed. Fifty-five percent was shipped by truck; 42 percent, by rail; and 3 percent, by water.

Stone.—Thirty-four companies crushed limestone at 42 quarries in 18 counties. Leading counties were Shelby, Jefferson, and Colbert. Leading producers were Lone Star Cement Corp., Birmingham Slag Co., Madison Limestone Co., and Southern Cement Co. Production increased 1 percent over the 1960 record. Of the total production, 59 percent was shipped by truck; 28 percent, by rail; 7 percent, by conveyor belt; and 6 percent, by water.

Alabama Limestone Co. quarried dimension limestone in Franklin County for rubble, rough architectural, sawed and cut dressed building stone, and for curbing and flagging. Production decreased 2 percent and was 40 percent below the 1956 record.

TABLE 7.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Autauga	148,300	$119.550	210,000	$207,850
Baldwin	8,505	8,505	----------	----------
Barbour	23,932	32,835	21,043	29,567
Calhoun	218,164	258,539	283,544	253,504
Cherokee	2,294	5,416	1,798	4,292
Chilton	202,000	164,700	(1)	(1)
Clarke	12,000	12,000	----------	----------
Conecuh	----------	----------	75,309	86,057
Dallas	256,224	274,681	148,000	182,300
Elmore	(1)	(1)	(1)	(1)
Escambia	(1)	(1)	(1)	(1)
Franklin	(1)	(1)	(1)	(1)
Greene	(1)	(1)	----------	----------
Houston	(1)	(1)	(1)	(1)
Jefferson	214,473	229,274	89,537	100,159
Macon	110,836	188,178	(1)	(1)
Mobile	(1)	(1)	513,316	911,466
Monroe	24,488	23,102	(1)	(1)
Montgomery	1,301,694	1,271,168	1,462,314	1,611,327
Morgan	(1)	(1)	(1)	(1)
Russell	147,161	152,208	(1)	(1)
St. Clair	1,498	3,373	605	1,361
Talladega	----------	----------	16,058	25,049
Tuscaloosa	(1)	(1)	(1)	(1)
Undistributed	1,687,067	2,015,575	2,978,420	3,038,990
Total	4,358,636	4,759,104	5,799,944	6,451,922

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

TABLE 8.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	1,369.685	$1,189,845	$0.87	1,611,600	$1,393,780	$0.86
Paving	541,388	432,132	.80	605,949	488,130	.81
Molding	94,950	217,821	2.29	85,626	200,230	2.34
Railroad ballast	12,746	6,919	.54	36,314	22,657	.62
Filtration	----------	----------	----------	20,000	13,000	.65
Fill	3,998	1,880	.47	13,573	6,349	.47
Gravel:						
Structural	1,007,166	1,342,796	1.33	1,803,641	2,470,210	1.37
Paving	1,071,127	1,281,962	1.20	1,450,966	1,655,079	1.14
Railroad ballast	(1)	(1)	(1)	54,250	51,787	.95
Other sand and gravel	[2] 257,576	[2] 285,749	[2] 1.11	[3] 118,025	[3] 150,700	[3] 1.28
Total	4,358,636	4,759,104	1.09	5,799,944	6,451,922	1.11

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other sand and gravel."

[2] Includes railroad ballast and other gravel.

[3] Includes other sand, fill and other gravel.

Thompson-Weinman & Co., Moretti-Harrah Marble Co., and Alabama Marble Co. crushed marble at Sylacauga for whiting, terrazzo, and other uses. Production decreased 5 percent below the 1960 record.

Moretti-Harrah Marble Co. and Alabama Marble Co. quarried dimension marble for exterior rough building stone; sawed interior, and cut dressed building stone; and for cut dressed monumental stone. Production expanded 30 percent above the 1960 record.

Radcliff Materials, Inc., and Southern Oystershell Milling Corp. crushed oystershell from Mobile Bay for cement, concrete and roads, and poultry grit. Production increased 24 percent compared with 1960, but was 38 percent below the 1957 record.

Universal Atlas Cement Co. and Sam P. Acton crushed sandstone for cement and refractories. Production decreased 23 percent from 1960 and was 90 percent below the 1956 record.

A. O. Brown quarried dimension sandstone for rough architectural building stone. Production increased 9 percent over that of 1960, but was 89 percent below the 1954 record.

TABLE 9.—Crushed limestone sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Cherokee	(1)	(1)		
Colbert	797,283	$951,256	1,200,735	$1,361,057
Conecuh	(1)	(1)	(1)	(1)
Covington	(1)	(1)	(1)	(1)
De Kalb	(1)	(1)	(1)	(1)
Etowah	(1)	(1)	(1)	(1)
Franklin	(1)	(1)	(1)	(1)
Henry	20,000	60,000	16,840	33,680
Jackson	58,104	72,630	(1)	(1)
Jefferson	3,213,149	3,541,744	3,494,818	3,922,966
Limestone	44,720	67,080	61,826	92,739
Madison	(1)	(1)	(1)	(1)
Marengo	(1)	(1)	(1)	(1)
Marshall	(1)	(1)	(1)	(1)
Morgan	(1)	(1)	(1)	(1)
St. Clair	(1)	(1)	(1)	(1)
Shelby	4,085,804	5,765,021	3,770,724	5,505,763
Talladega			(1)	(1)
Washington	(1)	(1)	(1)	(1)
Undistributed	4,970,404	5,185,867	4,809,222	5,084,099
Total	13,189,464	15,643,598	13,354,165	16,000,304

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Talc.—American Talc Co. mined and ground talc in Winterboro for insecticides, paint, toilet preparations, and pharmaceuticals. Production rose 93 percent above the 1960 record.

Vermiculite.—Zonolite Co. exfoliated vermiculite at its Birmingham plant, using crude vermiculite from out of State.

METALS

Aluminum.—Reynolds Metals Co. operated the Listerhill aluminum reduction plant at Sheffield.

Bauxite.—Harbison-Walker Refractories Co., R. E. Wilson Mining Co., and D. M. Wilson Bauxite Co. mined crude bauxite in Barbour and Henry Counties. Production declined 51 percent. Among the States, Alabama ranked third in the production of bauxite.

Iron Ore.—Shipments of iron ore were 12 percent less than in 1960 and the lowest since 1935. They were 59 percent below the 1942 record. Of the total shipments, 44 percent were direct-shipping ore,

TABLE 10.—Crushed limestone sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	5,731,089	$6,990,419	$1.22	6,495,775	$8,324,452	$1.28
Cement manufacture	2,909.122	2,093,221	.72	3,548,278	2,483,416	.70
Fluxing stone	1,548,053	2,444,560	1.58	1,269,291	2,047,720	1.61
Lime manufacture	941,018	1,095,819	1.16	772,190	965,200	1.25
Agstone	1,058,304	1,416,650	1.34	672,271	1,085,552	1.61
Stone sand	66,507	82.548	1.24	(1)	(1)	(1)
Riprap	625,483	883,046	1.41	(1)	(1)	(1)
Asphalt filler	44,295	199,328	4.50	50,000	200,000	4.00
Railroad ballast	19,328	25,550	1.32	(1)	(1)	(1)
Paper	(1)	(1)	(1)	26,807	63,495	2.37
Other uses [2]	246,265	412,457	1.67	519,553	830,469	1.60
Total	13,189,464	15,643,598	1.19	13,354,165	16,000,304	1.20

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[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other uses."
[2] Includes alkali, refractory, rock dust for coal mines, other uses, and uses indicated by footnote 1.

compared with 52 percent in 1960. The number of active mines decreased from 31 to 30, and average usable production per mine decreased from 137,000 tons to 120,000 tons. Among the States, Alabama ranked fifth in the production of iron ore.

Tennessee Coal & Iron, Woodward Iron Co., and Southeastern Coal & Iron Co. mined red iron ore (hematite) at three mines in Jefferson and Tuscaloosa Counties. Production decreased 19 percent compared with 1960 and was 66 percent below the 1942 record.

TABLE 11.—Usable iron ore shipments, by counties

County	1960		1961	
	Long tons	Value	Long tons	Value
Barbour	77,068	$398,914	53,999	$251,600
Blount	(1)	(1)	(1)	(1)
Butler	188,873	1,209,393	158,734	913,320
Calhoun	(1)	(1)	(1)	(1)
Cherokee	(1)	(1)	------------	------------
Crenshaw	39,633	299,553	(1)	(1)
Franklin	(1)	(1)	(1)	(1)
Jefferson	(1)	(1)	(1)	(1)
Pike	203,770	1,724,410	256,807	1,175,100
Shelby	5,066	30,401	(1)	(1)
Talladega	------------	------------	(1)	(1)
Tuscaloosa	(1)	(1)	(1)	(1)
Undistributed	3,553,274	19,848,556	3,127,262	18.170,332
Total	4,067,684	23,511,227	3,596,802	20,510,352

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[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Twenty-one operators mined brown iron ore (limonite) for pig iron and steel at 27 mines in 10 counties. Leading counties were Pike and Franklin. Leading producers were U.S. Pipe and Foundry Co., Glenwood Mining Co., Inc., and Shook & Fletcher Supply Co. Shipments were 8 percent below those of 1960 and 60 percent below the 1942 record.

TABLE 12.—Mine production and shipments of crude iron ore

	1960		1961	
	Number of mines	Long tons	Number of mines	Long tons
Mine production:				
By varieties:				
Hematite	4	3,317,487	3	2,688,269
Limonite	27	3,851,000	27	2,867,627
By mining methods:				
Open pit	28	4,014,369	28	2,878,053
Underground	3	3,154,118	2	2,677,843
Shipments from mines:				
Direct to consumers	4	2,097,317	4	1,594,509
To beneficiation plants	27	5,060,966	27	4,052,356

TABLE 13.—Usable iron ore production and shipments

	1960		1961	
	Long tons	Iron content natural (percent)	Long tons	Iron content natural (percent)
Production:				
Hematite	3,206,911	37	2,583,469	36
Limonite	1,028,548	45	799,683	47
Shipments:				
Direct shipping ore	2,097,317	37	2,005,000	36
Concentrates and sinter	1,970,367	45	1,592,000	47

Magnesium.—Alabama Metallurgical Corp. manufactured magnesium from dolomite at Selma.

Pig Iron and Steel.—Tennessee Coal & Iron, Republic Steel Corp., Woodward Iron Co., and U.S. Pipe & Foundry Co. produced 3,531,000 tons of foundry, basic, low-phosphorus, direct-casting, and malleable pig iron, compared with 3,545,000 tons in 1960. Value of shipments was $202,946,000, compared with $200,366,000 in 1960. Iron ore consumed in blast furnaces, steel mills, and agglomerating plants was 68 percent domestic and 32 percent imported. Imports of iron ore were 37 percent less than in 1960 and 55 percent below the 1959 record.

REVIEW BY COUNTIES

Mineral production was reported from 46 of the State's 67 counties, compared with 47 in 1960. Leading counties were Jefferson, Mobile, Walker, and Shelby, which together supplied 83 percent of the total value. A considerable quantity of sand and gravel was produced by the Alabama State Highway Department from various places throughout the State.

Autauga.—Dallas Sand & Gravel Co., Inc., mined building sand and fluxing gravel.

Baldwin.—Production of crude petroleum from 6 oil wells was 24 percent less than in 1960. Fairhope Clay Products Co. mined miscellaneous clay for heavy clay products.

Barbour.—H. D. Loflin, Rucker Mining Co., Davis Bros., and B & C Mining Co. mined brown iron ore for iron and steel. R. E. Wilson Mining Co. and D. M. Wilson Bauxite Co. mined bauxite for chemicals and refractories. Harbison-Walker Refractories Co. mined refractory kaolin for firebrick and block. McKenzie Construction Co. mined building and paving sand, and paving gravel.

Bibb.—Six coal mines were active; leading producers were Fitts & Gay Coal Co. (No. 1 strip mine) and Blocton Coal Co. (Belle Ellen No. 9 mine).

TABLE 14.—Value of mineral production in Alabama, by counties [1]

	1960	1961	Minerals produced in 1961 in order of value
Autauga	$119,550	$207,850	Sand and gravel.
Baldwin	(2)	(2)	Petroleum, miscellaneous clay.
Barbour	(2)	(2)	Iron ore, kaolin, bauxite, sand and gravel.
Bibb	90,664	151,936	Coal.
Blount	1,626,264	1,278,774	Coal, cement, iron ore, fire clay, sandstone.
Butler	1,209,393	913,320	Iron ore.
Calhoun	568,509	(2)	Sand and gravel, fire clay, iron ore, miscellaneous clay.
Cherokee	(2)	4,292	Sand and gravel.
Chilton	164,700	(2)	Do.
Choctaw	(2)	(2)	Petroleum.
Clarke	(2)	(2)	Do.
Colbert	(2)	(2)	Limestone, native asphalt.
Conecuh	(2)	(2)	Limestone, sand and gravel.
Covington	(2)	(2)	Limestone.
Crenshaw	299,553	(2)	Iron ore.
Cullman	415,249	186,957	Coal.
Dallas	274,681	(2)	Sand and gravel, lime.
De Kalb	(2)	(2)	Limestone.
Elmore	(2)	(2)	Sand and gravel, miscellaneous clay.
Escambia	(2)	(2)	Petroleum, sand and gravel, miscellaneous clay.
Etowah	(2)	(2)	Limestone.
Franklin	2,326,542	3,023,514	Iron ore, limestone, sand and gravel, fire clay.
Greene	(2)	----------	
Henry	(2)	(2)	Bauxite, limestone.
Houston	(2)	(2)	Sand and gravel.
Jackson	113,300	(2)	Coal, limestone.
Jefferson	106,485,039	96,722,493	Coal, cement, iron ore, limestone, miscellaneous clay, sand and gravel, sandstone, fire clay, lime.
Limestone	67,080	92,739	Limestone.
Macon	188,178	(2)	Sand and gravel.
Madison	(2)	(2)	Limestone, miscellaneous clay.
Marengo	(2)	(2)	Cement, limestone.
Marion	(2)	(2)	Coal, kaolin, natural gas.
Marshall	(2)	(2)	Limestone.
Mobile	(2)	(2)	Petroleum, cement, oystershell, sand and gravel, miscellaneous clay.
Monroe	23,102	(2)	Sand and gravel.
Montgomery	1,410,668	(2)	Sand and gravel, miscellaneous clay.
Morgan	(2)	(2)	Limestone, sand and gravel.
Pike	1,724,410	1,175,100	Iron ore.
Randolph	(2)	(2)	Mica.
Russell	497,251	(2)	Miscellaneous clay, sand and gravel.
St. Clair	(2)	(2)	Cement, limestone, miscellaneous clay, fire clay, sand and gravel.
Shelby	19,571,650	22,511,965	Cement, lime, limestone, coal, miscellaneous clay, iron ore.
Talladega	(2)	(2)	Marble, limestone, sand and gravel, talc, iron ore.
Tuscaloosa	4,443,740	3,886,211	Coal, iron ore, sand and gravel.
Walker	25,482,624	(2)	Coal, fire clay.
Washington	(2)	(2)	Limestone, salt, miscellaneous clay.
Winston	575,343	487,206	Coal.
Undistributed	[3] 49,829,510	83,769,643	
Total	[3] 217,507,000	214,411,000	

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[1] The following counties are not listed because no production was reported: Bullock, Chambers, Clay, Cleburne, Coffee, Coosa, Dale, Fayette, Geneva, Hale, Lamar, Lauderdale, Lawrence, Lee, Lowndes, Perry, Pickens, Sumter, Tallapoosa, and Wilcox.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Blount.—Five coal mines were active; leading producers were Robbins Coal Co., Inc. (Southview strip mine), Youngblood Coal Co. (Lehigh strip mine), and Alabama Coal & Ore Co., Inc. (Hopewell strip mine). Shook & Fletcher Supply Co. abandoned the Taits Gap mine, which had produced brown iron ore for many years, and reopened the old Champion brown iron ore mine. Cheney Lime & Cement Co. produced masonry and slag cements at the Graystone mill. Harbison-Walker Refractories Co. (Thermal mine) and Lehigh Coal Co. (Lehigh mine) produced fire clay for firebrick and block and for other refractories. A. O. Brown quarried a small quantity of dimension sandstone for rough architectural use.

Butler.—Seven companies mined brown iron ore for pig iron and steel; leading producers were Woodward-Acree Mining Co., KMC Mining Co., and Smith Mining Co.

Calhoun.—J. E. and F. D. Brown, and B. C. Ingram & Sons mined brown iron ore for pig iron and steel. Wade and Vance Sand & Gravel Co., Inc., and John B. Lagarde, Inc., mined structural sand and gravel. Donoho Clay Co. and Dixie Clay Co. mined fire clay. Agricola Brick Co. mined miscellaneous clay for heavy clay products.

Cherokee.—Wolf Creek Sand Co. mined a small quantity of molding sand.

Chilton.—Southeastern Sand & Gravel Co., Inc., mined building, paving, filter, and railroad ballast sand, and building, paving, and railroad ballast gravel.

Choctaw.—Crude petroleum production from 70 oil wells was 11 percent less than in 1960. One new producing well was drilled during the year.

Clarke.—Crude petroleum production from 13 wells increased considerably over 1960.

Colbert.—Alabama Asphaltic Limestone Co. (Margerum quarry) mined native asphalt for roadstone. Ralph Rogers & Co., Inc., Tri-States Limestone, Inc., and Alabama Asphaltic Limestone Co. (Maloney quarry) crushed limestone for roadstone, agstone, railroad ballast, and stone sand.

Conecuh.—Alabama Aggregate and Conecuh Lime Co., Inc., crushed limestone for roadstone and agstone. Castleberry Gravel Co. and the State highway department mined building and paving sand and gravel.

Covington.—Miller Lime Pit (Florala quarry) crushed limestone for roadstone and agstone.

Crenshaw.—McGhee & Merrill Co. (Searcy mine) mined brown iron ore for pig iron and steel.

Cullman.—Five coal mines were active; the leading producer was Marigold Coal, Inc. (No. 2 strip mine).

Dallas.—C. Pierson Cosby mined building, paving, fill, molding, and railroad ballast sand, and building, paving, railroad ballast and other gravel. Alabama Metallurgical Corp. produced dolomitic lime at Selma.

De Kalb.—Pearsall Limestone, Inc., crushed limestone for concrete and roads.

Elmore.—Alabama Gravel Co. mined structural sand and gravel. Jenkins Brick Co. mined miscellaneous clay for heavy clay products.

Escambia.—Crude petroleum production from 36 oil wells was about the same as in 1960. Dixie Sand & Gravel Co. and Flomaton Gravel Co., Inc., mined building, paving and fill sand and gravel. Keego Clay Products Co. mined miscellaneous clay for heavy clay products.

Etowah.—Republic Steel Corp. produced pig iron and steel at the Gadsden plant. Birmingham Slag and Alabama Aggregate crushed limestone for concrete and roads, agstone, and fluxing stone.

Franklin.—U.S. Pipe & Foundry Co. (Russellville No. 15 mine), Shook & Fletcher Supply Co. (Blackburn mine), and Walton, Hester & T. E. Farned mined brown iron ore for pig iron and steel. Alabama Limestone quarried dimension limestone at the Rockwood and Aday mine for rubble, rough architectural, veneer, sawed and dressed building, cut and dressed building, curbing and flagging. Clark & Ford, Inc. (Isbell quarry), crushed limestone for roadstone and agstone. Tennessee Valley Sand & Gravel Co. mined building and paving sand and gravel, and fire clay at the Spruce Pine mine.

Henry.—Harbison-Walker Refractories Co. mined bauxite for refractories. Abbeville Lime Co. crushed limestone for agstone.

Houston.—L. C. Smith Sand & Gravel Co., and Speigner Concrete Block Co. mined structural and fill sand and gravel.

Jackson.—Four coal mines were active; the leading producer was Reams & Smith Coal Co. (No. 1 mine). Porter Brown Limestone Co. crushed limestone for concrete and roads.

Jefferson.—Seventy-three coal mines were active; leading mines were the Maxine mine (Alabama By-Products Corp.), Concord No. 1 mine (Tennessee Coal & Iron), and Edgewater mine (Tennessee Coal & Iron).

Tennessee Coal & Iron operated the Wenonah red iron ore mines; Woodward Iron Co. operated the Pyne mine and made shipments from the Songo mine.

Tennessee Coal & Iron, Woodward Iron Co., U.S. Pipe & Foundry Co., and Republic Steel Corp. produced pig iron, and Tennessee Coal & Iron produced steel.

Universal Atlas Cement, Lehigh Portland Cement Co., Lone Star Cement Corp., and Alpha Portland Cement Co., produced masonry and portland cements; Southern Cement Co. produced masonry and slag cements. Eight quarries crushed limestone for cement, roadstone, agstone, fluxing stone, lime, railroad ballast, and refractories; leading producers were Dolcito Quarry Co., Tennessee Coal & Iron, and Universal Atlas Cement. Tennessee Coal & Iron (Ensley works) produced quicklime for chemical, industrial, and refractory uses. Seven companies mined miscellaneous clay for cement and heavy clay products; leading producers were Natco Corp., Lehigh Portland Cement Co., and Universal Atlas Cement.

Wade Sand & Gravel Co., Inc., mined structural sand and gravel. Universal Atlas Cement and Sam P. Acton crushed sandstone for cement and refractories. W. S. Dickey Clay Mfg. Co., Dixie Fire Brick Co., Inc., and Bibby Coal, Shale & Clay Co. mined fire clay for firebrick and block, fire-clay mortar, and heavy clay products. Zonolite Co. exfoliated vermiculite at its Birmingham plant, using materials from out of State.

Limestone.—Limestone County Board of Revenue crushed limestone for concrete and roads.

Macon.—Sharpe Sand & Gravel Co. and Tri-State Sand Co. mined molding, building and paving sand, and building and paving gravel.

Madison.—Madison Limestone Co., Inc. (Pluski Pike & Airport quarries), and Alabama Rock Co. crushed limestone for roadstone and agstone. Alabama Brick & Tile Co. and Huntsville Brick & Tile Co. mined miscellaneous clay for structural clay products.

Marengo.—Lone Star Cement Corp. produced portland cement at the Demopolis mill and crushed limestone for cement.

Marion.—Twenty-six coal mines were active; leading producers were Clifty Mining Co. (Brilliant mine), Brookside-Pratt Mining Co. (New River strip mine), and Wood & Burleson Coal Co. (No. 2 mine). Thomas Alabama Kaolin Co. mined kaolin at Hackelburg. A small quantity of natural gas was marketed.

Marshall.—C. A. Langford crushed limestone for roadstone and agstone.

Mobile.—Production of crude petroleum from 301 oil wells decreased 6 percent below 1960; during 1961, 41 new producing wells were drilled. Ideal Cement Co. produced portland cement at Mobile, using oystershell dredged from Mobile Bay. Radcliff Materials, Inc., and Southern Oystershell Milling Corp. dredged oystershells from Mobile Bay for concrete and roads, cement, and poultry grit. Radcliff Materials, Inc., mined building and paving sand and gravel. Ideal Cement Co. mined miscellaneous clay for cement.

Monroe.—Mannings Sand & Gravel Co. mined structural sand and gravel.

Montgomery.—Six companies mined building, paving, and railroad ballast sand and gravel; leading producers were Alabama Gravel Co., Birmingham Slag, and Southeastern Sand & Gravel. Jenkins Brick Co. and Excelsior Brick Co. mined miscellaneous clay for heavy clay products.

Morgan.—Trinity Stone Co., Inc., and Waters Quarries, Inc., produced limestone for riprap, concrete and roads, and agstone. Decatur Sand & Gravel Co. mined building and paving sand and gravel.

Pike.—Six mines produced brown iron ore for sale to iron and steel plants; leading producers were Glenwood Mining Co., Inc. (Spring Hill mine), and Henderson Mining Co. (Goshen mine).

Randolph.—Dixie Mines, Inc., mined and ground scrap mica for paint, roofing, and oil-well drilling. Small quantities of sheet mica were produced by Dixie Mines, Inc., and J. J. New.

Russell.—Bickerstaff Brick Co., Inc., Dixie Brick Co., and Bickerstaff Co., Inc., mined miscellaneous clay for heavy clay products. Consolidated Gravel Co., Inc., mined building, paving, and railroad ballast sand and gravel.

St. Clair.—National Cement Co. produced masonry and portland cements at the Ragland mill. National Cement Co. and Clemment Bros. crushed limestone for concrete and roads and cement. National Cement Co. and Ragland Brick Co. mined miscellaneous clay for cement and heavy clay products. Riverside Clay Co. (Pell City and Riverside mines) mined fire clay for foundries and steel works. Wolf Creek Sand Co. mined a small quantity of molding sand.

Shelby.—Thirteen coal mines were active; the leading producer was Southern Electric Generating Co. (Segco No. 2 mine). Shelby Sand & Ore Co. mined brown iron ore for pig iron and steel. Southern Cement Co. produced masonry and portland cements at the Calera mill. Five lime companies produced quicklime and hydrated lime for agricultural, building, chemical, and industrial uses; leading producers were Southern Cement Co. (Roberta limekiln) and Longview Lime Corp. (Saginaw limekiln). Ten quarries crushed limestone for concrete and roads, agstone, papermills, cement, lime, riprap, fluxing stone, magnesium metal reduction, railroad ballast, asphalt filler, rock dust for coal mines, chemicals, and stone sand; leading producers were Southern Cement Co. (Roberta quarry), Birmingham Slag (Calera quarry), and Alabama Aggregate (Pelham quarry). Southern Cement Co. mined miscellaneous clay for cement.

Talladega.—James Rucker mined brown iron ore at Sylacauga for pig iron and steel. Thompson-Weinman & Co., Moretti-Harrah Marble Co., and Alabama Marble Co. crushed marble for terrazzo, whiting, and other uses. Moretti-Harrah Marble Co. and Alabama Marble Co. quarried dimension marble for rough exterior; dressed, sawed, and cut interior and exterior building stone; and dressed, cut, monumental stone. Porter Brown Limestone Co. crushed limestone at Childersburg for concrete and roads. John B. Lagarde, Inc., mined structural sand and gravel. American Talc Co. mined talc at Winterboro for paint, insecticides, toilet preparations, and pharmaceuticals.

Tuscaloosa.—Nine coal mines were active; leading mines were the Riverbank strip mine (DeBardeleben Coal Corp.), the Kellerman No. 4 strip mine (Twin Seam Mining Co.), and the C. L. Abston Coal Co. strip mine. Southeastern Coal & Iron Co. mined red iron ore at Dudley. Shook & Fletcher Supply Co. mined brown iron ore at the Adkins mine. Yazoo Gravel Co., Inc., and Tuscaloosa Sand & Gravel Co. mined building, fill, and other sand and gravel.

Walker.—Fifty-one coal mines were active; leading producers were the Segco No. 1 mine (Southern Electric Generating Co.), and the Gorgas mine (Alabama Power Co.). Russell Coal & Clay Co., Natco Corp., and H. H. Taft Coal Co. mined fire clay for firebrick and block.

Washington.—Lone Star Cement Corp. produced crushed limestone and miscellaneous clay at the St. Stephens quarry. The materials were shipped to Louisiana for use in making cement. Mathieson Alabama Chemical Corp. recovered salt from brine at its plant near McIntosh.

Winston.—McCoy Coal Co. operated the Winston strip mine.

The Mineral Industry of Alaska

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Department of Natural Resources, State of Alaska.

By Kevin Malone,[1] Phil R. Holdsworth,[2] and Norma J. Fox[3]

⁂

PETROLEUM and natural gas again dominated the news of the mineral industry in Alaska in 1961. Value of oil and gas increased from $1.3 million in 1960 to $17.8 million as additional producing wells in the Swanson River field on the Kenai Peninsula were connected to the Swanson-Nikiski pipeline; pipeline capacity was increased from 10,000 to 30,000 barrels per day. The Kenai-Anchorage gasline was put into service in August, and thereby natural gas from the Kenai unit became available to the city of Anchorage. At the close of the year, Standard Oil Co. of California had almost completed development drilling at Swanson River; crude oil production was at the rate of 26,000 barrels per day. Additional testing of gas strata at Swanson River confirmed earlier indications of large gas reserves in the field. Union Oil Co. and Ohio Oil Co. outlined increased gas reserves at the Kenai unit (Kalifonsky Beach) through further drilling. On the Kenai Peninsula, Standard Oil Co. of California discovered gas at Falls Creek and Union-Ohio discovered gas at Sterling. No new oilfields were discovered.

Value of mineral production in Alaska increased 59 percent. The spectacular rise in value of oil and gas, from 6 percent of the total value of mineral products in 1960 to 51 percent in 1961, accounted for all of the increase. All other major mineral commodities except the platinum-group metals were less in value in 1961.

Coal was second in value among the mineral products of the State. Tonnage was 2 percent more than in 1960, but value, perhaps reflecting the industry's bid to retain military consumers after natural gas had come into the Anchorage area, was 7 percent less than in the preceding year. Output of sand and gravel was 13 percent less in quantity, and 24 percent less in value than in 1960. Operations of both commercial producers and Government agencies were less. Output of gold dropped sharply. Reduced activity in the dredge fields at Fairbanks and Nome was largely reflected by a 32-percent decrease in value of Alaska gold. When the closing of these fields was announced for the end of the 1963 season, the gold mining industry, for years the bulwark of the State's mineral production, seemed destined for a minor role in the mineral economy. Production of mercury, both in tonnage and value, was slightly less than in 1960. As in previous years almost all Alaska mercury was produced at the Red Devil mine of Alaska Mines and Minerals, Inc., Kuskokwim River region. Goodnews Bay Mining Co., operating placers near Platinum in the southwestern part of the Kuskokwim River region, was again the only producer of primary platinum in the United States. Yardage washed and metal recovered were greater than in 1960.

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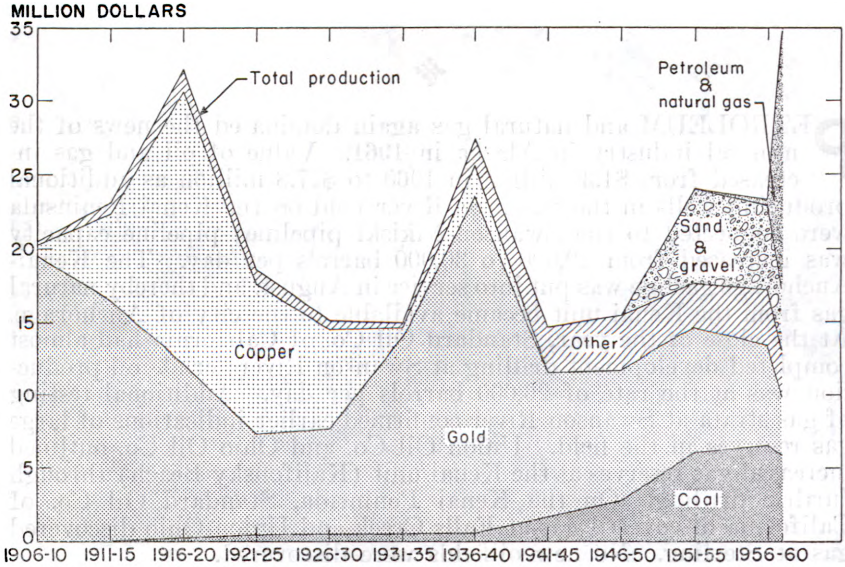

FIGURE 1.—Cumulative value of mineral production in Alaska, by major commodities, 1906–60 (5-year averages), and 1961, by year.

Exploration expenditures for metals and nonmetals decreased 16 percent. Interest in southeastern region mineral deposits, however, remained strong. About 10 mining companies had field parties or drill crews in the Southeastern region searching for copper, nickel, iron, limestone, gypsum, gold, and silver. Bear Creek Mining Co. (Kennecott Copper Corp. subsidiary) continued exploration on the Ruby Creek copper prospect, northwestern Alaska region. The company made public no reports on the deposits.

Employment.—Activity at 175 mining and milling operations furnished employment for 1,179 men, compared with 181 operations and 1,715 men in 1960. Eighteen purely prospecting or exploring operations employed 100 men. In addition, petroleum operations, including both exploration and production activities, employed 589 men.

Injuries.—Two fatalities marred the accident record for the State in 1961. A skindiver, placering for gold on Sixmile Creek near Hope on the Kenai Peninsula, was swept to his death into Turnagain Arm.

In December, a cave-in at the Suntrana coal mine (Nenana field) resulted in the death of one miner and serious injuries to two others. Lost-time accidents increased from 86 to 103. Time lost, not including two open cases from the Suntrana accident, was 2,029 days. For statistical purposes, a fatality was entered as 6,000 days lost; the figures need to be increased by 12,000 to allow for the two fatalities noted.

TABLE 1.—Mineral production in Alaska[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays short tons	1,150	$10		
Coal (bituminous) thousand short tons	722	6,318	737	$5,868
Copper (recoverable content of ores, etc.) short tons	41	26	92	55
Gold (recoverable content of ores, etc.) thousand troy ounces	168	5,887	114	3,998
Mercury 76-pound flasks	4,459	940	4,129	816
Natural gas million cubic feet	246	30	631	129
Petroleum (crude) thousand 42-gallon barrels	559	1,230	[2] 6,325	[2] 17,647
Sand and gravel thousand short tons	6,013	5,483	5,241	4,185
Silver (recoverable content of ores, etc.) thousand troy ounces	26	23	18	17
Stone thousand short tons	275	852	(3)	(3)
Value of items that cannot be disclosed: Gem stones, lead, peat (1960), platinum-group metals, stone (1961), and uranium		[4] 1,061		2,018
Total Alaska		[4] 21,860		34,733

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[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Preliminary figure.
[3] Figure withheld to avoid disclosing individual company confidential data included with "Value of items that cannot be disclosed."
[4] Revised figure.

TABLE 2.—Expenditures by major companies for exploration and prospecting

(Thousand dollars)

Type and region	Expenditures	
	1960	1961
Metals exploration:		
Southeastern Alaska	$1,300	$1,000
Copper River and Prince William Sound	25	20
Kuskokwim River and Yukon River	85	75
Northwestern Alaska	400	550
Other	290	125
Total metals	2,100	1,770
Oil and gas:		
Exploration, development, and production	35,000	
Exploration		24,405
Development and production		18,000
Total oil and gas	35,000	42,405
Grand total	37,100	44,175

Source: Division of Mines and Minerals, Department of Natural Resources, Alaska.

TABLE 3.—Coastwise receipts and foreign mineral trade

Commodity	1959			1960		
	Coast-wise receipts	Im-ports	Ex-ports	Coast-wise receipts	Im-ports	Ex-ports
Anthracite, bituminous coal and lignite, coal and coke briquettes, and coke..........short tons..	857	30	--------	815	20	--------
Motor fuel and gasoline..........thousand barrels..	2,328	7	--------	2,326	7	(1)
Gas, oil, distillate, and residual fuel oil..........do....	4,373	--------	--------	5,114	13	(1)
Petroleum asphalt..........short tons..	4,429	--------	--------	12,044	--------	--------
Lubricating oil and greases..........thousand barrels..	30	--------	--------	53	--------	--------
Petroleum products, not elsewhere classified....do....	146	13	--------	93	--------	--------
Building cement..........376-pound barrels..	302,426	154	--------	377,539	36,793	--------
Building, monument, and other stone manufacturers, not elsewhere classified..........short tons..	3,499	--------	--------	1,904	--------	--------
Clays and earths..........do....	1,340	784	--------	39	--------	--------
Brick and tile..........do....	1,910	--------	--------	1,310	--------	--------
Sulfur..........do....	--------	8,110	--------	--------	7,952	--------
Sand, gravel, and crushed rock, including limestone short tons..	739	--------	--------	14,306	--------	--------
Iron ore and concentrates..........do....	153	--------	--------	110	--------	--------
Iron and steel scrap..........do....	524	--------	6,257	220	--------	2,394
Iron and steel products..........do....	31,370	--------	--------	35,077	17,379	170
Aluminum metal and alloys in crude and semifabricated forms..........short tons..	307	--------	--------	724	--------	--------
Copper semifabricated forms..........do....	532	--------	--------	743	--------	--------
Lead and lead-base alloys in crude and semifabricated forms..........short tons..	20	--------	--------	6	--------	--------
Other nonferrous ores, concentrates, metals and scrap, except precious, in crude and semifabricated forms short tons..	16	--------	--------	--------	--------	--------
Fertilizer materials..........do....	1,417	956	--------	3,230	2,204	--------

[1] Less than 1,000 barrels.

Source: Waterborne Commerce of the United States, Part 4, Pacific Coast, Alaska, and Pacific Islands, calendar years, 1959–60, by the U.S. Army Corps of Engineers.

Wages and Hours.—Mines in Alaska operated an average of 138 days. The seasonal nature of many mining operations and the reductions in operations part way through the season in the Fairbanks and Nome dredge fields combined to produce the low figure for days operated.

For the minerals industries covered by the Employment Security Act (operators with hired labor), monthly earnings averaged $839. Monthly earnings in metal mining were $619, in nonmetals, $712; in coal mining, $955; and in oil and gas (production and exploration), $958.

TABLE 4.—Number of establishments in the mineral industries in 1961, classified by number of employees

Type of operation	Number of establishments employing—			
	1–9	10–19	20–29	30 and over [1]
Metal mines [2]..........	125	7	2	5
Nonmetal mines..........	43	1	--------	--------
Quarries and mills [2]..........	3	1	--------	1
Coal mines..........	--------	1	1	3
Total..........	171	10	3	9

[1] Includes 3 operations employing 30–39; 4 operations, 40–49; 1 operation, 60–69; 1 operation, 90–99.

[2] Includes assessment, exploration, and development operations.

TABLE 5.—Employment and injuries in the mineral industries in 1961[1]

Type of operation	Number of men working (average)	Number of days worked (average)	Man-days	Injuries (number)	
				Fatal	Nonfatal
Metal:					
Lode	54	206	11,101		9
Mills	5	313	1,565		
Placer:					
Dredge	310	144	44,566		38
Nonfloat	156	89	13,944		5
Hydraulic	18	107	1,925		
Small-scale hand	3	70	210		
Assessment, exploration, development, and/or prospecting[2]	119	95	11,270	1	3
Nonmetal mines[3]	356	90	31,871		
Quarries and mills	74	101	7,490		
Coal	184	288	53,041	1	48
Total	1,279	138	176,983	2	103

[1] Excludes officeworkers.

[2] Includes 31 men in placer assessment, exploration, development and/or prospecting; 84 in lode, and 4 in limestone exploration.

[3] Sand and gravel operations.

Legislation and Government Programs.—Establishment of an all-rail link between Alaska and the States to the south through a Canadian interconnection was recommended by the Alaska International Rail and Highway Commission in its report to the Congress. Along with the economic advantages that all-rail service would bring in the development of Alaska and the Canadian Northwest, the commission stressed the importance of the service to the Defense Department and civilian defense. Construction of a 380-mile extension to the Alaska Railroad (ARR) from Rex Station, 65 miles south of Fairbanks, to the international boundary at a point 25 miles north of the Alaska Highway, and extension of Canadian rail lines through Summit Lake, north of Prince George, to Whitehorse and thence to the ARR eastern terminus would effect the connection. Estimated cost of the Alaska section was $114 million. Under highway projects, the Commission recommended construction and hard surfacing of a Hazelton-Atlin-Alaska Highway road, using 194 miles of the Stewart-Cassiar Highway; construction of hard-surfaced feeder highways from the Hazelton-Atlin-Alaska Highway project to the Alaska port cities of Petersburg, Wrangell, and Juneau; relocation of parts of the Haines cutoff to make it an all-weather route; and upgrading, minor relocation, and line improvements of 790 miles of the Alaska Highway. Also recommended was a ferry system joining southeastern Alaska coastal cities with mainland highways through Prince Rupert, British Columbia. The State government had the ferry project well under way at yearend; funding, engineering studies on routes and terminals, and bids for equipment were completed. Passenger, automobile, and freight service were to be provided from Juneau-Haines to Prince Rupert along the Inside Passage.

In June, State officials met with counterparts from British Columbia and the Yukon Territory in a 2-day conference aimed at planning and coordinating goals in the fields of resources development, transportation, and communications. Matters discussed included paving the Alaska Highway, the impact of the new ferry system on the region, hydroelectric developments, and a regionally integrated pipeline system. Representatives of the Federal Governments of both Canada and the United States joined in the conference.

Lease applications on 400,000 acres of potential oil lands on the Kenai Moose range just south of the recently discovered oil and gas fields were denied by the Department of the Interior. Because 168 applications, some of which were filed as far back as 1954, were rejected, southern parts of the range were closed to oil development.

Studies of Project Chariot, the proposal to create an artificial harbor near Cape Thompson 100 miles north of the Arctic Circle on the Chukchi Sea through use of nuclear explosives, continued during the year. Six large-diameter drill holes ranging from 17 to 27 feet in depth were put down in the frozen mudstone at Cape Thompson. Plans called for blasting the holes in the 1963 season, using 1,000 pounds of conventional high explosives per hole so that scientists might make additional studies of basic engineering characteristics of the mudstone and obtain data on cratering effects as related to depth of charge. A preliminary cratering experiment in which a 256-pound charge of high explosive was detonated at a depth of 8.7 feet was conducted in November 1960. Project Chariot required Presidential approval and no date for the nuclear explosions was set. If approved, five nuclear devices were scheduled to be exploded to create the manmade harbor. Four of the devices were to be 20 kiloton charges, the fifth was to be a 200 kiloton charge.

Arthur D. Little, Inc., under a contract with the State, reported on its study of the economy of Alaska. The Little report, stressing the awareness of Japanese and United States businessmen of high labor costs in Alaska, stated that growth in the State would depend on development of metals and minerals, including coal, oil, and natural gas, and hydroelectric power. Sections of the report dealt in detail with the following topics: Economics of Alaska Coal Development, Liquefied Methane Shipment from Alaska to Japan, Alaska Iron and Copper Deposits, A Refinery for Alaska, and Pipelining Arctic Crude to Tidewater.

The Secretary of the Interior announced at midyear that gold, silver, iron ore, bismuth, sulfur, and tellurium had been added to the list of minerals eligible for exploration aid under the Office of Minerals Exploration (OME). The latter participated to the extent of 50 percent in exploration costs for the eligible commodities on approved projects. Repayment to the Government would be from royalties on ore discovered; if ore were not discovered, the Government contribution would be canceled with no further liability to owners or operators. At yearend, OME was considering an application for an exploration loan on a lode-gold property in the Chandalar area.

State legislation included a bill providing for new mining regulations. Of particular interest was a provision for mineral prospecting permits, allowing a prospector 2 years to search for minerals on State-owned land. During this time, he was protected from any adverse entry and was assured of the right to file for a noncompetitive lease on any valuable mineral found. The regulations included State-owned offshore lands.

Transportation.—Although approval of higher waterborne freight rates, increased 10 percent on an interim basis in January 1960, still was being considered by the Federal Maritime Commission, Alaska Steamship Co. applied for additional increases in rates ranging from 10 to 20 percent, late in December. Rates on groceries shipped by barge into Anchorage from west coast ports were reduced 15 to 47 percent. Use of shipping vans to unitize lots allowed the reduced rates. Surcharges on shipments from Japan to Alaska were reduced from the 30-percent rate previously in effect to 10 percent. Cement, pipe, fertilizer, and steel and iron products were excepted from the surcharge.

The Griffiths Line of Seattle began weekly barge service to southeastern Alaska in September. The new service was equipped to handle both van and railroad car shipments. Griffiths, hauling chemicals and supplies for Alaska Lumber and Pulp Co., had been operating between Sitka and Seattle exclusively. Organization of a new firm to provide combination highway-water service from Prince Rupert, British Columbia, to southeastern ports was announced in December. Alaska-Seattle Motor Express planned to haul freight in vans to Prince Rupert thence via the new Alaska ferry system to southeastern destinations. The new service was to replace the all-water shipping service of Ketchikan Merchants Cooperative Association. Canadian National Railways, in cooperation with the Alaska Railroad, announced plans for rail-water service from the Eastern and Central United States to Port Whittier (near Anchorage) and points on the Alaska Railroad. Service, to include shipment in freight cars and piggybacking of trucks, was to start in the spring of 1962.

Commercial operations of the Port of Anchorage facility began in the spring. Original estimates that the port would handle 130,000 tons proved over optimistic; tonnage for the year was approximately 38,000 tons from some 200 vessels using the new dock. Tonnage for 1962 was estimated to reach 85,000. Increased shipments from Japan, transportation of drilling equipment for the oil industry, and shipments of military supplies were expected to provide most of the additional tonnage.

TABLE 6.—Freight rates,[1] Seattle to selected Alaskan cities

(Cents per hundred pounds)

Commodity	Seattle to—					
	Seward		Anchorage via Seward		Fairbanks via Seward	
	1960	1961	1960	1961	1960	1961
Machinery	161	160	257	317	300	431
Groceries	170	170	--------	327	--------	441
Do 24,000-pound minimum	--------	--------	260	260	344	344
Do 60,000-pound minimum	--------	--------	233	233	292	292
Diesel oil	150	150	--------	--------	--------	--------
Do 30,000-pound minimum	--------	--------	210	210	308	308
Ores and concentrates (southbound only)[2]	86	86	--------	--------	--------	--------
Do[2] 20,000-pound minimum	--------	--------	125½	135½	161	171

[1] Effective June 1, 1959, rates include all-risk insurance.

[2] Value not to exceed $60 per ton. Rate increases 25 percent for each additional $60 (or fraction) per ton valuation.

Source: Alaska Steamship Co.

Federal appropriations for road construction in the fiscal year ended June 30, 1962, were $37 million. U.S. Department of Agriculture, Forest Service highway funds and National Park Service road funds totaled $3.2 million. Funds available from all sources for roadbuilding, including State matching funds and pioneer access-road funds, totaled $42.4 million. By the end of the 1961 construction season, the Federal Bureau of Public Roads had completed its administration of all highway contracts in Alaska outside of the Forest Service and National Park Service road programs.

In southeastern Alaska, work on the section of road from the Shrine River to the Herbert River was substantially completed. Construction of the Eagle River to Yankee Cove road was well underway. Both were in the Juneau area. At Ketchikan, the Clover Pass to Lunch Creek Highway was opened. Initial work was started on the section from Blind Slough to Dry Strait at Petersburg. Grading of the Nenana-Rex State Highway 3 in central Alaska was completed. On the Seward Peninsula, work was in progress on the Nome end of the Penny River-Sinuk River section and on the Bluestone-Teller section of the Nome-Teller Highway. Bridges were constructed at the East Fork of the Solomon, the Fox River, and Bear Creek on the Nome-Council road.

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Antimony.—Extensive repairs and additions were made to the mill at the Stampede mine, northeast of Kantishna, during the year. A pioneer access road linking Stampede with Lignite on the Alaska Railroad was within a mile of connecting with the mine road. The mine operators, planning to ship antimony concentrates to Japan, were negotiating for a contract with Japanese interests at yearend.

The Alaska Mines and Minerals, Inc., Red Devil mine made one shipment of mercury soot containing high antimony to Japan for test purposes.

Beryllium.—The Federal Bureau of Mines continued to study the beryllium resources of Alaska. It did fieldwork on the Seward Peninsula and in southeastern Alaska. Work on the Seward Peninsula included examinations of pegmatitic and nonpegmatitic deposits associated with tin-tungsten-fluorine mineralization at Ear Mountain, Cape Mountain, and Lost River.

Copper.—Only a small quantity of copper was produced in Alaska in 1961. Exploration continued on deposits in southeastern Alaska, Copper River, and northwestern Alaska regions. Bear Creek Mining Co., exploration subsidiary of Kennecott Copper Corp., was again active at the Ruby Creek copper prospect, northwest of Shungnak.

Gold.—Value of gold produced decreased 32 percent to just below $4 million and was only 12 percent of the value of the State mineral output. Except during World War II years when gold mining was discontinued or restricted by Government order, 1961 output of gold was the lowest since the Nome placers were discovered in 1898. Reduced operations in the dredge fields at Nome and Fairbanks largely caused the lower value of production. The combination of the sharp decrease in gold output coupled with the impressive rise in value of petroleum and natural gas only served to accentuate the declining importance of gold mining in Alaska. When the United States Smelting, Refining, and Mining Co., the only major gold operator still active in Alaska, announced that the Nome and Fairbanks dredge fields were to be closed by the end of the 1963 season (and for Nome, perhaps by 1962), it was apparent that gold mining would no longer be

TABLE 7.—Mine production of gold, silver, and other metals,[1] in terms of recoverable metals[2]

Year	Mines producing		Material sold or treated[3] (Short tons)	Gold (lode and placer)		Silver (lode and placer)		Other		Total value (thousands)
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)	4	135	7,166	240,288	$8,410	32,825	$30	3	$1	$8,441
1957	4	87	11,626	215,467	7,541	28,862	26	9	3	7,570
1958	3	108	55	186,435	6,525	23,507	22	7	3	6,550
1959	2	94	617	178,918	6,262	21,358	19	36	22	6,303
1960	6	92	234	168,197	5,887	25,934	23	64	32	5,942
1961	8	86	645	114,216	3,998	18,485	17	116	60	4,074

[1] Includes copper, lead, and zinc produced.

[2] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore shipped to smelters during calendar year indicated.

[3] Does not include gravel washed.

TABLE 8.—15 leading gold-producing mines in 1961, in order of output

Rank in 1961	Rank in 1960	Mine	District	Region	Operator	Source of gold
1	1	Fairbanks Unit	Fairbanks	Yukon River	United States Smelting, Refining & Mining Co.	Dredge (4).
2	2	Nome Unit	Nome	Seward Peninsula.	do	Dredge (2).
3	5	Hogatza River	Hughes	Yukon River	do	Dredge (1).
4	4	Chicken Creek	Fortymile	do	do	Dredge (1).
5	3	Nyac	Aniak	Kuskokwim River.	New York-Alaska Gold Dredging Corp.	Dredge (2).
6	6	Otter Creek	Iditarod	Yukon River	Otter Dredging Co	Dredge (1).
7	12	Fish Creek	Fairbanks	do	Wolf Creek Mining Co	Nonfloat.
8	7	Woodchopper Creek.	Circle	do	Mathews Mining Co	Dredge (1).
9	13	Prince Creek	Iditarod	do	Prince Creek Mining Co	Nonfloat.
10	9	Flat Creek	do	do	Flat Creek Placers	Do.
11	(1)	Long Creek	Ruby	do	Ruby Mining Co	Hydraulic.
12	14	Solomon River	Nome	Seward Peninsula.	Lee Bros. Dredging Co	Dredge (1).
13	(1)	Livengood Creek	Tolovana	Yukon River	Redstone Mine	Nonfloat.
14	(1)	Kougarok River	Kougarok	Seward Peninsula.	N. B. Tweet & Sons	Do.
15	11	Inmachuk River	Fairhaven	do	Inmachuk Mining Co	Dredge (1).

[1] Not among the 15 highest in 1960.

a significant factor in the State's economy. Lode gold mining, once a major part of the economy, had been of little importance since the forced shutdown of World War II. Activity in lode mining remained slight. Value of lode gold produced was only $27,000, compared with $7 million in 1941.

More than 99 percent of the 1961 gold output came from placer mines. Total gravel washed was 11.1 million cubic yards compared with 14.3 million in 1960. Of the total, dredges supplied 10.3 million yards (13.0 million in 1960); nonfloat plants, 773,000 yards (1.2 million in 1960); and hydraulic and small-scale hand mining, 40,000 yards (44,000 in 1960). Average value of gravel washed by all methods was 35.7 cents per cubic yard compared with 40.9 cents in 1960. For dredging, average value per cubic yard was 32.0 cents (37.4 cents in 1960) and for nonfloat 73.4 cents (75.8 cents in 1960).

TABLE 9.—Gold produced at placer mines, by classes of mines and methods of recovery

Class and method	Mines producing [1]	Washing plants	Material treated (thousand cubic yards)	Gold recovered		
				Troy ounces	Value	Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucketline dredges:						
1952–56 (average)	13	22	12,573	189,559	$6,634,558	$0.528
1957	12	21	14,287	177,563	6,214,705	.435
1958	13	22	16,043	150,342	5,261,970	.328
1959	13	22	12,478	146,886	5,141,010	.412
1960	15	22	12,988	138,620	4,851,700	.374
1961	16	21	10,315	94,488	3,307,080	.320
Nonfloating washing plants: [2]						
1952–56 (average)	83	83	2,856	47,618	1,666,616	.584
1957	70	70	2,224	36,211	1,267,385	.570
1958	78	78	2,077	34,664	1,213,240	.584
1959	64	64	1,578	30,307	1,060,745	.672
1960	60	60	1,229	26,602	931,070	.758
1961	57	57	773	16,209	567,315	.734
Gravel hydraulically handled:						
1952–56 (average)	14	----------	51	947	33,145	.650
1957	3	----------	116	974	34,090	.295
1958	9	----------	34	567	19,845	.587
1959	8	----------	25	522	18,270	.729
1960	11	----------	43	1,447	50,645	1.178
1961	10	----------	39	2,673	93,555	2.378
Small-scale hand:						
1952–56 (average)	24	----------	24	751	26,278	1.095
1957	2	----------	19	314	10,990	.575
1958	8	----------	14	662	23,170	1.657
1959	9	----------	11	585	20,475	1.895
1960	6	----------	1	153	5,355	5.366
1961	3	----------	1	87	3,045	2.643
Underground placers (drift):						
1952–56 (average)	1	----------	([3])	16	553	2.304
1957–61	----------	----------	----------	----------	----------	----------
Grand total placers:						
1952–56 (average)	135	----------	15,505	238,891	8,361,150	.539
1957	87	----------	16,645	215,062	7,527,170	.452
1958	108	----------	18,168	186,235	6,518,225	.359
1959	94	----------	14,092	178,300	6,240,500	.443
1960	92	----------	14,261	166,822	5,838,770	.409
1961	86	----------	11,128	113,457	3,970,995	.357

[1] Excludes itinerant prospectors, "snipers," "highgraders," and others, who gave no evidence of legal right to property.

[2] Includes all placer mines, using both power excavator and washing plant on dryland; when washing plant is movable, outfit is termed "dryland dredge."

[3] Less than 1,000 cubic yards.

TABLE 10.—Mine production of gold and silver in 1961, by months, in terms of recoverable metals [1]

Month	Gold (troy ounces)	Silver (troy ounces)	Month	Gold (troy ounces)	Silver (troy ounces)
January	----------	----------	August	21,200	4,240
February	----------	----------	September	20,400	3,320
March	300	60	October	22,927	3,635
April	1,700	400	November	9,104	1,443
May	5,500	1,100	December	1,685	277
June	14,300	1,980			
July	17,100	2,030	Total	114,216	18,485

[1] Derived from mint and smelter receipts and producers' reports.

TABLE 11.—Production of gold and silver at placer mines in 1961, by regions and districts

Region and district	Mines producing	Gold (troy ounces)	Silver (troy ounces)	Total value
Cook Inlet-Susitna: Yentna	2	67	11	$2,355
Copper River: Chistochina	1	40	3	1,403
Northwestern Alaska: Kiana	1	432	48	15,164
Seward Peninsula:				
Fairhaven	7	1,622	196	56,951
Kougarok	4	1,755	168	61,580
Koyuk	3	619	48	21,709
Nome	4	26,442	3,036	928,277
Yukon River:				
Chandalar	1	11	2	387
Circle	6	2,087	193	73,223
Fairbanks	9	44,653	6,761	1,569,105
Fortymile	5	5,869	1,256	206,576
Hot Springs	5	1,062	286	37,434
Iditarod	5	5,911	871	207,690
Innoko	9	2,528	333	88,788
Kantishna	1	470	137	16,577
Koyukuk	5	386	35	13,542
Melozitna	1	152	15	5,334
Rampart	4	257	20	9,013
Ruby	2	1,439	218	50,567
Other districts [1]	11	17,655	1,151	618,991
Total	86	113,457	14,788	3,984,666

[1] Includes 5 districts for which production was unreported by producer and the following districts for which quantities and values cannot be shown separately: 1 in Hope, Kenai Peninsula region; 3 in Aniak, 1 in Goodnews Bay, Kuskokwim River region; 1 in Council, 2 in Port Clarence, Seward Peninsula region; 1 in Hughes, and 2 in Tolovana, Yukon River region.

TABLE 12.—Production of gold, silver, and other metals [1] at lode mines, in terms of recoverable metals

Year	Mines producing	Gold		Silver		Other		Total value (thousands)
		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)	4	1,398	$49	556	$1	3	$1	$51
1957	4	405	14	1,836	2	9	3	19
1958	3	200	7	587	1	7	3	11
1959	2	618	22	869	1	36	22	45
1960	6	1,375	48	3,044	3	64	32	83
1961	8	759	27	3,697	3	116	60	90

[1] Includes copper, lead, and zinc.

TABLE 13.—Equipment used at placer gold mines in 1961, by regions

Region	Number of operations [1]	Gravel washed (thousand cubic yards) [2]	Equipment used (number)				
			Bulldozers	Draglines	Hydraulic giants	Dredges	Other [3]
Bristol Bay	1	----------	----------	----------	----------	----------	----------
Cook Inlet-Susitna	2	7	6	1	1	----------	----------
Copper River	2	2	1	----------	----------	----------	----------
Kenai Peninsula	1	12	2	1	----------	----------	----------
Kuskokwim River	4	1,145	3	----------	2	3	----------
Northwestern Alaska	1	39	----------	----------	----------	1	----------
Seward Peninsula	25	2,784	26	2	19	8	3
Yukon River	65	7,139	67	17	70	10	2
Total	101	11,128	105	21	92	22	5

[1] Includes equipment at 1 operation from which gold is a byproduct of platinum-group recovery and at 15 operations, which conducted assessment, maintenance, or preparatory work but made no valuable mineral recovery.
[2] Partly estimated.
[3] Includes hydraulic elevator, power unit, diesel pump, and screen stackers.

Twenty-one dredges (excluding Goodnews Bay Mining Co. where gold was a byproduct of platinum mining) mined gold during the year. U.S. Smelting, Refining, & Mining Co. (USSR&M) in the Yukon River and Seward Peninsula regions, New York-Alaska Gold Dredging Corp. in the Kuskokwim River region, and Otter Dredging Co. in the Yukon River region were the leading producers. USSR&M operated four boats in the Fairbanks district, one at Hogatza River (Hughes district), one at Chicken (Fortymile district), and two at Nome. New York-Alaska used two dredges at Nyac (Aniak district), and Otter Dredging one at Flat (Iditarod district). Other dredging operations, some of them of small scale, were at Woodchopper Creek (Fairbanks district), Klery Creek (Kiana district), Solomon, Kougarok, Inmachuk and Niukluk Rivers (Seward Peninsula), and Gaines and Flat Creeks (Iditarod district).

Nonfloat plants (where gravel is delivered to washing plants by bulldozer or dragline) decreased from 60 to 57. Yardage handled was 37 percent less than in 1960, and value of output declined 39 percent. The value per yard decreased from 75.8 cents in 1960 to 73.4 cents.

As in past years, the Fairbanks district, Yukon River region, was the leading gold-producing district. The Nome district ranked second, followed by the Hughes, Fortymile, and Aniak districts.

Placer miners reported the sale of 960 ounces of natural gold (nuggets, grains, and dust, not melted or amalgamated) to buyers and jewelers; this was slightly higher than the figure for 1960.

Iron Ore.—Exploration of iron ore deposits, particularly in southeastern Alaska, continued. Economic studies by private consulting firms, sponsored by the State as an aid to future development or by the U.S. Army Corps of Engineers in connection with the proposed hydroelectric project at Rampart on the Yukon River, stressed the potential inherent in Alaska's iron ore resources. Both studies envisioned an iron ore concentrating industry and, perhaps, pig iron manufacturing for the State as cheap hydropower became available.

A significant discovery of natural gas close to a large iron ore deposit might also provide the conditions necessary to exploit such deposits.

Columbia Iron Mining Co., subsidiary of United States Steel Corp., exercised its option on the huge lode and residual placer deposits at Klukwan, near Haines in the southeastern region.

Mercury.—Value of mercury produced was 13 percent less than in 1960, as the tonnage mined decreased 7 percent, and the average price per flask declined from $210.76 to $197.61. Alaska Mines and Minerals, Inc., operator of the Red Devil mine in the Kuskokwim River region, again furnished almost the entire State output. Some operators were prospecting for or exploring mercury deposits in the central Kuskokwim area. The Federal Bureau of Mines continued to explore the White Mountain prospect, 60 miles southeast of McGrath, Kuskokwim River region. Work accomplished in the 1961 field season gave additional evidence of important mercury mineralization at White Mountain; further exploration was planned for the 1962 field season.

TABLE 14.—Mercury production

Year	Number of producing mines	76-pound flasks	Value [1]	Year	Number of producing mines	76-pound flasks	Value [1]
1952-56 (average)	2	887	$230,858	1959	2	3,743	$851,458
1957	2	5,461	1,348,758	1960	3	4,459	939,779
1958	2	3,380	774,223	1961	2	4,129	815,932

[1] Value calculated at average New York price.

Nickel.—Newmont Exploration, Ltd., had a crew that diamond-drilled the Brady Glacier nickel deposit near Cape Spencer, southeastern Alaska. The company, reportedly, intended to do additional exploration in the 1962 field season. Admiralty Alaska Gold Mining Co. explored the Funter Bay nickel deposit on Admiralty Island. Exploration work on the Emerick nickel-copper deposit at Rainbow Mountain, Delta River district, Yukon River region was continued. In the fall, Newmont Exploration, Ltd., reportedly, optioned the latter property and was planning an exploration program for the 1962 season.

Platinum-Group Metals.—Goodnews Bay Mining Co. was again the only producer of platinum as a primary product in the Nation. The company had dredging operations at Platinum in the extreme southwestern part of the Kuskokwim River region.

Scrap Metals.—Small quantities of ferrous and nonferrous scrap were shipped from the State. Most of the ferrous scrap was shipped from Anchorage to Japan.

Silver.—Production of silver, largely a byproduct of gold placering, declined considerably as gold production decreased. Some interest was shown in lode silver deposits in the Kantishna district, Yukon River region, and the Hyder district, southeastern Alaska region.

Tungsten.—Activity at tungsten deposits was limited to assessment work. One operator in southeastern Alaska stockpiled hand-cobbed ore and gravity concentrate.

Uranium.—Bay West, Inc., reactivated the Ross-Adams deposit on Bokan Mountain, Prince of Wales Island, southeastern Alaska region. It shipped to a custom mill in the Pacific Northwest and began an exploration and development program. Shattuck Denn Mining Corp. was reported to have an interest in this venture.

The U.S. Army Corps of Engineers' nuclear powerplant (SM–1A) at Fort Greely was under test at yearend. Designed as a stationary unit for use at isolated or remote locations, the nuclear plant was rated at 1,640 kilowatts electric net plus 46 million Btu-per-hour steam for space heating.

MINERAL FUELS

Coal (Bituminous).—Coal ranked second to petroleum and natural gas in value of production. The U.S. Armed Forces were the chief consumers of Alaskan coals. Military contracts for fiscal year 1962 totaled 577,000 tons, compared with 514,000 tons for fiscal 1961. Usibelli Coal Mine, Inc., produced 382,000 tons and was the leading contractor. Evan Jones Coal Co. (130,000 tons), Mrak Coal Co. (45,000 tons), and Cripple Creek Coal Co. (20,000 tons) were other contractors. In December, a cave-in at the Usibelli Suntrana underground mine resulted in the death of one miner and serious injuries to two others. This was the first fatality in coal mining in Alaska since December 6, 1959.

Strip mines produced 85 percent of Alaska coal in 1961, compared with 91 percent in 1960. Usibelli Coal, which took over the Suntrana underground mine at Nenana late in 1960, was the only company producing more than 1,000 tons of underground coal in Alaska in 1961.

An estimated 78 percent of the coal was sold for heat and power at Fort Wainwright and Eielson Air Force Base near Fairbanks, Fort Richardson and Elmendorf Air Force Base near Anchorage, Clear Missile Tracking Station near Nenana, and at other military installations in Alaska. Additional quantities were sold to local utility companies for heat and power and to consumers for heating and cooking. The value of all coal produced averaged $7.96 per ton, compared with $8.75 per ton in 1960. Lower contract prices for military sales were responsible for the decrease.

TABLE 15.—Coal production by fields

(Thousand short tons and thousand dollars)

Year	Field						Total	
	Matanuska		Nenana		Barrow			
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1955	258	$3,055	381	$2,690	1	$14	640	$5,759
1956	269	3,273	457	3,055	1	46	727	6,374
1957	237	2,947	604	4,337	1	12	842	7.296
1958	290	3,532	468	3,392	1	7	759	6,931
1959	251	2,977	409	2,892			660	5,869
1960	300	3.434	422	2,884			722	6,318
1961	226	2,443	511	3,425			737	5,868

Four strip mines and one underground mine were active, compared with six and two, respectively, in 1960. The Suntrana underground mine at Nenana, taken over by Usibelli Coal in the fall of 1960, operated throughout the year; the Evan Jones underground mine at Jonesville was not operated in 1961. Coal output continued to come from the Matanuska field, Cook Inlet-Susitna region, and the Nenana (Healy River) field, Yukon River region; only a small quantity came from the Barrow field, northern Alaska region. Of total tonnage mined, 40 percent, compared with 47 percent in 1960, was cleaned.

The power needs of the Railbelt area were studied by Ralph M. Parsons Co., a private consulting firm, for the central Alaska power pool. The pool, made up of the cities of Anchorage, Seward, and Fairbanks, and the Chugach, Homer, and Golden Valley Matanuska, electric associations, was formed to seek means of meeting a predicted serious power shortage for the Railbelt area by 1964 as well as to make long-term plans for future power requirements. Among other solutions to Railbelt power problems, Parsons recommended a 44,000-kilowatt coal-fired generator at Sutton, and a similar plant at Healy by 1964–65.

Coal-mine operators, as natural gas became available in the Anchorage area, were studying the potentials for coal in the Japanese markets. The Japanese, however, had embargoed imports of steam coal. Arthur D. Little, Inc., in a report, "Potential Use of Alaska's Energy Resources," estimated that Alaskan coal would have to be landed in Japan at a cost not to exceed 30 cents per million Btu before application of import duty or taxes, to compete with other forms of fuel.

No fieldwork was done in the Bering River coalfield in 1961.

Petroleum and Natural Gas.—Emergence of the Swanson River field as an oil producer of national rank was a news feature of the petroleum industry in 1961. At yearend the Swanson-Nikiski pipeline was moving 26,000 barrels per day; Alaska had risen to 20th among oil-producing States. Value of crude oil production, at $17.7 million, was 51 percent of the value of the State's mineral production.

Of 27 development wells completed at the Swanson River field in 1961, 24 were producing oil wells and 3 were dry holes; 3 wells were under test as the year closed. In addition, three stepout exploratory wells were brought in as producers and two exploratory gas wells came in as gassers. Development drilling was expected to be completed early in 1962. When Swanson River was put wholly on a production basis, plans were to use natural gas from upper zones to repressure the field; the natural gas would have to be compressed before it could be reinjected into the Hemlock producing zone.

At midyear, Standard Oil Co. of California, operator of Swanson River (with Richfield Oil Corp., holder of a major interest), announced plans for a $10 million, 20,000-barrel-per-day refinery to be built near the Nikiski terminal on the Kenai Peninsula. Target date for completion was set as mid-1963; the prospect of beginning production late in 1962 was good. In October, Standard purchased 481 acres adjacent to the Nikiski terminal from the State of Alaska for the refinery site for $250,000. Initial production was to be heating oils, diesel fuels, jet fuels, and fuel oils for sale in Alaska. As the economy of the State grows, the refinery might be expanded to produce gasoline. The proposed refinery was expected to employ 25 men. Earlier in the year Western Frontier Oil and Refining Co. of Long Beach, Calif., announced plans for a 2,000-barrel-per-day topping unit on the Kenai Peninsula to produce gasoline, kerosine, jet fuel, diesel fuel, and bunker oils.

TABLE 16.—Exploration drilling for petroleum in 1961

Unit	Location	Company	Wells							
			Drilling, start of year	Spudded	Completions	Drilling, end of year	Oil productive	Gas	Dry [2] holes	Feet drilled
Swanson River.[1]	Kenai Peninsula.	Standard-Richfield.	------	1	1	------	------	1	------	7,800
Soldatna Creek.[1]	do	do	1	3	4	------	3	1	------	30,006
Falls Creek	do	do	1	------	1	------	------	1	------	7,321
Chaix Hills	Icy Bay	do	------	2	1	1	------	------	1	15,449
Anchor River	Kenai Peninsula.	do	------	1	1	------	------	------	1	6,896
Swan Lake	do	do	------	1	1	------	------	------	1	11,984
Kaliakh River	Yakataga	Richfield-Sinclair-BP.	1	------	1	------	------	------	1	1,603
Duktoth River	do	do	------	1	1	------	------	------	1	10,390
White River	do	do	------	1	1	------	------	------	1	7,982
Bering River	do	do	------	2	1	1	------	------	1	11,010
Kenai	Kenai Peninsula.	Union-Ohio	1	1	2	------	------	1	1	5,991
Sterling	do	do	------	1	1	------	------	1	------	14,832
Fish Creek	Big Lake	do	------	1	1	------	------	------	1	6,418
Napatuk Creek.	Bethel Basin	Pan American.	------	1	1	------	------	------	1	14,910
West Foreland.	Cook Inlet	do	------	1	------	1	------	------	------	12,013
Stedatna Creek-State.	do	do	------	1	------	1	------	------	------	5,179
Canoe Bay	Alaska Peninsula.	Pure Oil	------	1	1	------	------	------	1	6,642
Rosetta	Houston	Hackathorn	------	1	1	------	------	------	1	2,407
Chuit-State	Cook Inlet	Superior	------	1	------	1	------	------	------	580
Total			4	21	20	5	3	5	12	179,413

[1] The 2 units together are the Swanson River field.

[2] 2 dry holes in Swanson River unit and 1 in Soldatna Creek unit, classed as development drilling, are not included.

Source: Alaska Division of Mines and Minerals.

TABLE 17.—Acreage under oil and gas lease

Year	Thousand acres	Year	Thousand acres
1954	1,833	1958	27,900
1955	2,519	1959	34,265
1956	2,815	1960	33,287
1957	6,516	1961	26,808

Source: (1954–58) Bureau of Land Management; (1959–61) Geological Survey, U.S. Department of the Interior.

Standard of California increased the posted price of Swanson River crude oil three times during the year. Two of the increases, 20 cents and 8 cents per barrel, resulted from lower transportation costs as the daily rate of oil flow increased from 6,000 to 26,000 barrels. Kenai

Pipe Line Co., operator of the Swanson-Nikiski line announced the lower rates. The third increase—25 cents per barrel—was attributed by Standard both to increased operating efficiency and to higher rates of production in the field. The three increases, totaling 53 cents per barrel, established the prices for Swanson River crude at $2.41 for 25°–25.9° (API) to $3.29 for 40°–40.9° oil. Kenai Pipe Line Co. increased storage capacity at Nikiski by 200,000 barrels; capacity of the Swanson-Nikiski line was 30,000 barrels per day at yearend. Optimum daily operating rate was set at 28,000 barrels.

By the close of 1961, Swanson River was established as an important oilfield among the Nation's producers. With 45 producing wells at yearend, up from 17 at the beginning of the year, production was 6.3 million barrels, a 215-fold increase over the 29,000 barrels produced in 1958. Cumulative production to the end of 1961 totaled 7.1 million barrels. Unofficial estimates placed reserves recoverable by primary methods at 100 to 200 million barrels. At the 26,000-barrels-per-day production rate in effect at yearend, the Swanson River oilfield was producing at a yearly rate of almost 10 million barrels.

Exploration activity continued strong throughout the State. Including 3 stepout wells at the Soldatna Creek unit, 21 exploratory wells were spudded, and 4 wells spudded in 1960 were completed. Exploratory drilling was done on 19 different field units. Additionally, four core holes were drilled in a series of stratigraphic tests at Yakutat. Of the 21 wells spudded in 1961, 16 were completed for a total of 20 completions in 1961; 5 wells were being drilled at yearend. The three Soldatna Creek stepout wells became oil producers. Of the remaining 17 completions, 5 were gassers and 12, dry holes; thus, except at Soldatna Creek, none of the new wells struck oil. Exploration drilling totaled 179,413 feet and the total including the Yakutat core drilling was 199,143 feet. A great deal of geological and geophysical work was also done, mostly in the Arctic Slope, the Gulf of Alaska area, and the Cook Inlet-Susitna region, and also on the Alaska Peninsula, Copper River Basin, Nushagak Basin, Porcupine-Kandik area, Middle Tanana Basin, and southeastern Alaska.

Developments in natural gas, although not as spectacular as those in oil, were nevertheless substantial. In early summer, the Turnagain Arm crossing of the Kenai-Anchorage gasline was successfully laid with heavy-duty pipelaying equipment brought in from the Gulf of Mexico; a 1960 attempt using light equipment had been unsuccessful. When this gasline was completed, Anchorage Natural Gas Corp. began service in August; by yearend consumption of gas was estimated at 3.5 million cubic feet daily. Capacity of the Kenai-Anchorage line was given as 70 million cubic feet per day.

On the Kenai Peninsula, new gas discoveries were made at Falls Creek by Standard-Richfield, at the Sterling and the Kenai units by Union-Ohio, and at the Swanson River and the Soldatna Creek units by Standard-Richfield. The Falls Creek discovery was made offshore from a shore-based drilling site. The Swanson River and Soldatna Creek work showed new gas zones in these units, thus confirming earlier indications that the Swanson River field had large gas reserves. Additional drilling at the Union-Ohio Kenai unit (Kalifonsky Beach) added to reserves; the Kenai unit was estimated to contain 3 to 5 trillion cubic feet of gas.

Feasibility studies on exploitation of Kenai gas, both as a liquefied natural gas (LNG) for shipment to the Orient and the west coast and as a base for a petrochemical industry in Alaska were under serious consideration. At first Japan was considered the best near-term market for LNG and the California market out of reach economically for firm-load LNG; Kenai gas, however, was thought to be competitive with out-of-State gas for the California peak-load supply. Union announced that construction of chemical and fertilizer plants in Alaska was being considered.

Four competitive sales of oil and gas leases, spaced throughout the year, netted the State more than $22 million on 161 tracts covering 297,000 acres. In addition, leases on 82 tracts covering 197,000 acres in Alaska were awarded in a noncompetitive lease drawing held in July.

Six development contracts, covering 2,853,000 acres, were approved by the Secretary of the Interior. Areas leased were at Nushagak Bay (Pure Oil Co.), Baird Inlet (Pan American Petroleum Corp.), Icy Bay (Standard Oil Co. of California), Glenallen (Pan American Petroleum Corp.), Kahiltna River (Pure Oil Co.), and Becharof Lake (Mobile Oil Co.).

NONMETALS

Gem Stones.—Four producers reported small quantities of raw jade, valued at $2.75 per pound, from Dahl Creek, Shungnak district, northwestern Alaska region. Shungnak Jade project continued to purchase jade produced on the Shungnak and Kobuk Rivers and on Dahl Creek from Eskimo claim owners. The project, operated by Eskimos under the sponsorship of the Indian Arts and Crafts Board, supervised cutting, processing, and polishing jade into shapes for jewelry and souvenirs. Other jade miners in the Shungnak district produced jade for domestic use or for export. Small quantities of mineral specimens, including natural gold, were collected and sold to mineral dealers and hobbyists.

Sand and Gravel.—Output of sand and gravel decreased 13 percent in quantity and 24 percent in value because both commercial producers and Government agencies reduced operations.

Average value per ton of all sand and gravel was $0.80 compared with $0.91 in 1960. Material used for State and Federal projects supplied 88 percent of total tonnage and 72 percent of total value. Of all output, 824,000 tons (16 percent) valued at $2.11 per ton was washed, compared with 1.33 million tons (22 percent) at $1.88 per ton in 1960. Value of unwashed sand and gravel was $0.55 per ton ($0.64 in 1960). Nine commercial operators and 9 State and Federal agencies or their contractors produced sand and gravel, compared with 10 commercial and 9 Government-and-contractor producers in 1960. Commercial producers included the Alaska Railroad, an agency of the Department of the Interior; the railroad was classified as a commercial producer to permit comparability with data published for other States.

Commercial producers supplied 629,000 tons or 12 percent of the output, averaging $1.87 per ton in value. Sixty-eight percent of commercial output, valued at $2.27 per ton was washed; the value of

TABLE 18.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

	1960		1961	
	Quantity	Value	Quantity	Value
Sand:				
Structural	288	$932	105	$330
Paving	633	985	412	449
Railroad ballast	47	16	----------	----------
Fill	194	419	----------	----------
Gravel:				
Structural	330	110	139	258
Paving	958	694	2,101	1,533
Railroad ballast	120	113	63	60
Fill	3,374	2,032	2,205	1,188
Other sand and gravel [1]	69	182	216	367
Total	6,013	5,483	5,241	4,185

[1] Includes "Other construction" and "Industrial" sand, and "Other construction," "Miscellaneous" gravel.

unwashed material was $1.00 per ton. Nine percent of the output of Federal and State agencies, valued at $1.93 per ton, was washed; unwashed material was valued at $0.53 per ton.

The Alaska Division of Highways, the Federal Aviation Agency, the U.S. Army Corps of Engineers, and the Federal Bureau of Public Roads were the major producers. Alaska Division of Highways furnished 58 percent of the tonnage credited to State and Federal agencies and 46 percent of the value. The Federal Aviation Agency, a new major sand and gravel producer, supplied 14 percent of the tonnage and 28 percent of the value of material produced for State and Federal agencies.

TABLE 19.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1960		1961	
	Quantity	Value	Quantity	Value
Crushed and broken:				
Riprap	83	$149	(1)	(1)
Concrete and roadstone	192	703	(1)	(1)
Other [2]	----------	----------	(1)	(1)
Total	275	852	(1)	(1)

[1] Figure withheld to avoid disclosing individual company confidential data.
[2] Includes rock sill and breakwater.

Stone.—Tonnage of stone produced increased but value of output was less than in 1960. Value decreased because a greater proportion of stone output went into road work rather than into construction. Stone was valued at $2.61 per ton in 1961 compared with $3.10 in 1960. Government agencies or their contractors supplied 97 percent of the tonnage and 99 percent of the value. The Alaska Division of Highways, in its first full year of responsibility for construction and maintenance of the State highway system, produced 80 percent of the stone used and 68 percent of its value. The U.S. Army Corps of Engineers, previously a leading producer of stone supplied 17 percent of the tonnage and 30 percent of the value. The Alaska Railroad (ARR), owned and operated by the Federal Government, was the only stone producer classified as commercial. ARR figures were classified as commercial to make stone figures for Alaska comparable with those of other States.

REVIEW BY REGIONS

Because the Swanson River field supplied crude oil that was 51 percent of the total value of mineral production in the State, the Kenai Peninsula led in mineral output. The Yukon River region, producing coal from the Nenana field and placer gold from the dredge fields of Fairbanks, ranked second. The Cook Inlet-Susitna region, yielding coal from the Matanuska field and sand and gravel, ranked third.

TABLE 20.—Value of mineral production in Alaska, by regions [1]

(Thousand dollars)

Region	1960	1961	Minerals produced in 1961 in order of value
Alaska Peninsula	------------	$29	Sand and gravel.
Aleutian Islands	$76	63	Sand and gravel, stone.
Bristol Bay	28	34	Sand and gravel, stone, gold.
Cook Inlet-Susitna	5,506	4,217	Coal, sand and gravel, stone, gold, silver, copper.
Copper River	165	424	Sand and gravel, stone, copper, silver, gold.
Kenai Peninsula	[2] 1,900	17,804	Petroleum, natural gas, stone, sand and gravel, gold, silver.
Kodiak Island	89	1	Sand and gravel.
Kuskokwim River	2,111	2,203	Platinum-group metals, mercury, gold, sand and gravel, silver.
Northern Alaska	21	28	Natural gas.
Northwestern Alaska	33	30	Gold, gem stones, copper, silver.
Seward Peninsula	1,676	1,640	Gold, sand and gravel, silver.
Southeastern Alaska	932	737	Sand and gravel, stone, uranium, gem stones, lead, gold, silver.
Yukon River	9,323	7,523	Coal, gold, sand and gravel, stone, silver, gem stones, copper.
Total	[2] 21,860	34,733	

[1] No mineral production from Bering Sea region.
[2] Revised figure.

Kuskokwim River, the only region where the metals dominated, led in producing platinum-group metals, mercury, and gold; the region ranked fourth in value of mineral production. No minerals were produced from the Bering Sea region.

Alaska Peninsula.—Socony Mobil Oil Co., in an agreement with a group of independent leaseholders, was preparing to renew exploratory drilling in the Lake Becharof area. It spent more than $4 million on two dry holes on the peninsula from 1950 to 1959. Richfield Oil was high bidder on three offshore tracts covering 19,000 acres in the Pavlof Bay area; the tracts were offered at the State's fifth competitive lease sale held in May. Cities Service Petroleum Co. applied for 34,000 acres in the Port Heiden area. Pure Oil Co. drilled Canoe Bay No. 1 (Pavlof Bay area) to 6,642 feet; the well was plugged and abandoned as a dry hole.

Aleutian Islands.—Sand and gravel and stone were the only mineral commodities produced; value was small.

Bristol Bay.—Humble Oil and Refining Co. made geophysical and geological surveys at its Kemuk Mountain iron claims, north of Dillingham, Nushagak subdistrict. Pure Oil Co. received a 5-year contract on 477,000 acres near the mouth of the Nushagak River from the Department of the Interior. The lease required the company to drill three exploratory wells and to spend a minimum of $1,175,000 over the 5-year period.

Cook Inlet-Susitna.—Coal from the Matanuska field, and sand and gravel, the leading mineral commodities of the region, supplied almost the entire $4.2 million value of production. Small quantities of stone, gold, silver, and copper were produced.

Coal was produced entirely from the Matanuska field; it decreased 29 percent in value and 25 percent in tonnage. Value per ton declined from $11.43 to $10.82. Military contracts for coal required less tonnage and lower price per ton. An estimated 78 percent of coal was sold to the Armed Forces. Coal from the region was entirely strip-mined. The Evan Jones underground mine at Jonesville was not operated in 1961.

Exploration work was completed by the Bureau of Mines on the Beluga River coal deposits in the 1961 field season. This work disclosed five seams of subbituminous coal. Indicated reserves were calculated at 20 million tons of coal in the newly discovered seam; additional exploration could well increase indicated reserves considerably. The thickness of this seam averaged 50 feet or more; overburden ranged from 0 to 250 feet in depth. Columbia Iron Mining Co. (United States Steel subsidiary) obtained prospecting permits on coal lands in the Beluga River field. The company had a geological party in the area in the 1961 season and reportedly planned additional work for the summer of 1962. A Bureau of Mines report summarizing the work on the Beluga coals was in process at yearend.

Means of meeting the power shortage of the Railbelt area were studied by a firm of consulting engineers for the city of Anchorage and other Railbelt communities. Among other things, the report recommended coal-fired steamplants of 44,000 kilowatt at Sutton (Matanuska field) and at Healy near Fairbanks.

The Cook Inlet-Susitna region again led in production of sand and gravel in the State. Five commercial operations and five Government agencies produced 905,000 tons valued at $1.5 million. The U.S. Army Corps of Engineers was the leading producer both in tonnage and value.

In August, natural gas from the Kenai Peninsula was piped into Anchorage. Heavy-duty pipelaying equipment was brought into Cook Inlet from the Gulf of Mexico to complete successfully the troublesome Turnagain Arm crossing of the Kenai-Anchorage line; an attempt to lay the Turnagain section with lighter equipment in the summer of 1960 was unsuccessful because of heavy winds, strong tides, and two deep channels in the Arm.

Five exploration oil wells were spudded in the Cook Inlet-Susitna, and one previously abandoned well was reentered for testing. Union Oil Co.-Ohio Oil Co. drilled the Fish Creek unit 12–8 to 6,418 feet; the well was a dry hole. The Hackathorn Drilling Co. Rosetta No. 4A at Houston was abandoned at 2,407 feet. At yearend, wells were being drilled by Pan American Oil (West Foreland No. 1 and Stedatna-State No. 1) and Superior Oil Co. (Chuit-State No. 1). Belco Petroleum Corp. reentered but later abandoned the Antonio Zappa No. 1 at Iniskin after strata testing.

Permanente Cement Co. continued fieldwork on its limestone deposits on the East Fork of Kings River in the Castle Mountain area (Willow Creek district). In 1960 the company had announced plans for a 500,000-barrel-a-year cement plant at Anchorage or Sutton if exploration of the deposits was favorable.

Gold was added to the list of minerals eligible for Government aid in cost of exploration through Office of Mineral Exploration loans, but there was little activity in the goldmining districts of the region.

The Bureau of Reclamation reported the proposed $500 million Devil Canyon hydroelectric project to be economically feasible. Two large dams on the Susitna, feeding a 580,000-kilowatt plant centrally located between Fairbanks and Anchorage, were estimated to be capable of providing power anywhere in the Railbelt area for about 6 mills per kilowatt hour.

Copper River.—Value of mineral production of the region was only 1 percent of the State total. Sand and gravel and stone supplied 86 percent of value of mineral output; copper, silver, and gold composed the remainder.

Exploration for oil at Yakataga and surrounding area continued. Wells were completed at the Kaliakh, Duktoth, White, and Bering River units operated by Richfield Oil Corp. All the wells were dry holes. Sinclair Oil & Gas Co. and BP Exploration (Alaska), Inc., joined Richfield in the Yakataga venture early in the year. At yearend the companies were drilling the Bering River unit No. 2. The Richfield-Sinclair-BP unit was high bidder on five of six tracts offered at the State's sixth competitive lease sale. Socony Mobil Oil Co. took one tract. The tracts were tidelands in the Yakataga area. Pan American Petroleum Corp. was awarded a 615,000-acre development contract in the Glenallen-Nelchina area by the Department of the Interior. Geological or geophysical work and three wells were required within 3 years.

The Kennecott Copper Corp. holdings in the old camp of La Touche were sold to Anchorage investors. Town buildings, mine and mill buildings, and 400 acres of land were transferred. The new owners planned to develop La Touche as a resort.

No fieldwork was done at the Bering River coalfield.

Kenai Peninsula.—Establishment of the Swanson River field (the field consisted of the Swanson River unit and the Soldatna Creek unit) as an oil producer of national rank and plans for refining Swanson crude oil at Nikiski were outstanding developments in the region and in the State. By yearend, Standard Oil Co. of California, operator of Swanson River, had almost completed development drilling of Swanson; the field was expected to be producing routinely early in 1962. With 45 producing or producible wells at the close of the year, Standard was pumping almost 26,000 barrels of crude per day through the Swanson-Nikiski pipeline; operating target rate for the 30,000-barrel-capacity line was given as 28,000 barrels.

During the year, 11 wells were spudded in the Swanson River unit, and 1 was drilled as a directional redrill. One well was being drilled as the year began. Of the 13 wells, 9 were completed as producing oil wells; 1, as a gas well; 2 were dry holes; and 1 was being tested at the end of the year. In the Soldatna Creek unit, 20 wells were spudded in 1961, and 2 were being drilled as the year began. Of the 22 wells, 18 were completed as producing oil wells; 1, as a gas well, 1 was a dry hole; and 2 were being tested at yearend. Thus, for the Swanson field, 35 wells were spudded or completed in 1961; 27 wells were producing oil; 2 were gas wells, and 3 were dry holes; 3 of the wells were under test as the year closed. Thirty of the Swanson wells were classed as development drilling; the remaining 5, as exploratory. Development drilling in the two units of Swanson River totaled 313,839 feet for the year. Exploration drilling totaled 37,806 feet.

At the Kenai unit (gas) of Union Oil of California and Ohio Oil Co., a well spudded in 1960 was completed as a dry hole, the first miss for Union-Ohio in the field. A directional redrill from this well was brought in as a gas well.

In exploratory drilling elsewhere on the peninsula, the Standard-Richfield combine drilled dry holes at the Anchor River unit and the Swan Lake unit. A well drilled at the Falls Creek unit by the same combine was brought in as a gasser. Falls Creek, 20 miles southwest of the Kenai unit, was the fifth gas discovery on the peninsula; others were Kenai unit (Union-Ohio), West Fork unit (Halbouty Alaska Oil Co.-King Oil, Inc.), Sterling unit (Union-Ohio), and Swanson River-Soldatna Creek units (Standard-Richfield).

Gas from the Sterling discovery was chosen as the fuel for a 1,500-kilowatt generating plant to serve the town of Kenai and surrounding area. Construction and hookup were completed by yearend, and the plant was ready to begin service.

There was little activity in other sectors of the mineral industry in the region. Small quantities of stone, sand and gravel, gold, and silver were produced. Skindivers were active for placer gold in the Hope-Moose Pass district.

Kodiak.—The U.S. Navy reported production of a small quantity of sand and gravel from Kodiak—the only mineral output.

Kuskokwim River.—Metals composed 99 percent of the value of output; the region ranked fourth in the State. Platinum-group metals, mercury, and gold were almost the entire output; a small quantity of silver was produced as a byproduct of gold and platinum placer operations.

Production of mercury, both in volume and in value, was somewhat less than in 1960. Alaska Mines and Minerals, Inc., Red Devil mine, Aniak district, Georgetown subdistrict, supplied almost the entire output in the State. The only other production recorded came from the Alice and Bessie mine (formerly the Parks) also in the Georgetown subdistrict. Because of these two properties, Alaska ranked third in the Nation and furnished 13 percent of U.S. mercury output. Mercury soot that contained a large quantity of antimony was shipped to Japan by Alaska Mines and Minerals. The soot was flown to Anchorage and loaded on Japanese vessels for shipment to Japan.

Red Devil did no surface exploration in 1961, but continued underground exploration and development. The main shaft (incline) was sunk below the 600 level and a station was cut.

Elsewhere in the region, Willis and Murphy worked the Alice and Bessie mercury mine, 2 miles below Red Devil on the north bank of the Kuskokwim. Hand-cobbed high-grade ore was treated in a two-tube Joshua Hendy-McKay retort first used at the Willis deposit in 1917. Holloway and partner prospected a mercury deposit 1 mile above Sleetmute on the west bank of the river. At the Schaefer Cinnabar Creek deposit, 85 miles southwest of Sleetmute, some diamond drilling was done in an effort to determine the extent of the deposit as disclosed by surface work; seven men were employed in the exploration. The Bureau of Mines continued trenching and diamond drilling at the White Mountain deposit, 60 miles south of McGrath. Fieldwork in 1961 gave further evidence of important mercury mineralization at White Mountain.

At Nyac, 60 miles northeast of Bethel, New York-Alaska Gold Dredging Corp. operated two dredges on the Tuluksak River gold placers. Gold recovered, although somewhat less than in 1960, was significant in mineral production from the Kuskokwim River region; in the State, the U.S. Smelting, Refining, and Mining Co., led, and Nyac ranked second in output of gold.

At Platinum, 125 miles west of Dillingham, Goodnews Bay Mining Co., dredged for the platinum-group metals. Yardage washed and output of metal were somewhat greater than in 1960. The company operated only one dredge in the 1961 season. As in the past, Goodnews Bay was the only mining company in the Nation that produced platinum as a primary product.

Lode gold mining was almost at a standstill. Strandberg Mines, Inc., milled a small lot of good-grade ore and treated a few tons of old tails from the Nixon Fork lode near Medfra. At other gold-lode properties only annual assessment work was done.

Pan American Petroleum Corp. completed the Napatuk Creek No. 1 well at a depth of 14,910 feet. The well, a dry hole, bottomed in sedimentary rocks of undetermined age. Napatuk Creek No. 1 was the westernmost well drilled in the United States. In May, the Department of the Interior approved a development contract with Pan American on 586,000 acres in the Baird Inlet area, adjacent to the company holdings at Napatuk Creek. Requirements called for at least three exploratory wells and an expenditure of $950,000 over a 5-year period. Pan American also was required to relinquish one-half of the acreage before the beginning of the 12-month period during which the drilling of the third well was to start.

Northern Alaska.—The region had no appreciable mineral output. A small quantity of coal—less than 1,000 tons—was mined from the Meade River deposits for use at Barrow. Gas wells on Naval Petroleum Reserve No. 4 supplied 173 million cubic feet of natural gas valued at $28,000 and used at Government agencies in Barrow and the Puget Sound and Drake powerplants.

Because of the renewed interest of major oil companies in the Arctic Slope region, the Bureau of Land Management announced, late in the year, that it was preparing for a lease sale of lands in the Colville River area near Naval Petroleum Reserve No. 4. In the 1961 season, 10 field parties, representing 5 oil companies, made geological studies on the Arctic Slope; total work amounted to 26 party-months.

Northwestern Alaska.—Gold, gem stones, copper, and silver were the only mineral commodities produced; the value was only a fraction of 1 percent of the mineral output in the State.

Bear Creek Mining Co., the Kennecott Copper Corp. exploration subsidiary, examined the Ruby Creek copper deposit near Kobuk in the Shungnak district and north of the Arctic Circle. It was reported to have 5 diamond drills in use on a 2-shift basis during the 1961 field season; at the peak of operations, more than 50 men were employed at the project.

Studies on Project Chariot, the proposed construction of an artificial harbor at Cape Thompson by nuclear explosives, were continued during the year. Possible effects of the nuclear blast on the biosphere were being examined closely; if found tolerable to human and other life, four 20-kiloton and one 200-kiloton explosions were planned to create a channel 900 by 2,000 feet.

Eight prospecting permits, each covering 2,560 acres, were granted on coal deposits along the Kukpowruk River. Preliminary examinations and laboratory tests in 1961 were reported as favorable; plans were to bring in drilling and other gear for detailed examination in the summer of 1962. Japan was seen as a market for Kukpowruk coal if exploration disclosed enough reserves of suitable quality.

Seward Peninsula.—Value of gold produced in the region decreased 34 percent from the 1960 figure; this decline was caused by the reduced operations of U.S. Smelting, Refining, and Mining Co. (USSR&M) in the once great dredge fields of Nome. Only two USSR&M dredges were active in the 1961 season; the average crew was reduced from 70 men in the 1960 season to 47 men. A spokesman for the company announced that Nome operations were to be shut down at the close of the 1962 season or early in 1963. Rising costs combined with a fixed price for product were given as the reasons forcing the closure. Heavy equipment and stocks of spare parts were to be stored at Nome awaiting a possible change for the better in goldmining economics. The Nome fields were reported to contain 20 years or more of reserves at the 1948 operating rates and costs. The year 1948 was the first routine operating season following the disruptions of World War II and the rescinding of War Production Order L–208, which forced the closing of the gold mines following its issuance in 1942.

In the 1961 season at Nome, No. 6 dredge, digging 27 feet below sea level to reach pay dirt, worked the submarine beach. No. 5 dredge worked gravels on Dry Creek. All other USSR&M dredges were idle. The company did no thawing in 1961.

Other dredging on the Seward Peninsula included Nugget Mining Co. (Niukluk River), Inmachuk Mining Co. (Inmachuk River), Lucky Syndicate (Macklin Creek), and Lee Bros. Dredging Co. (Solomon River). Nonfloat plants were operated by Foster Mining Co., Inc. (Hannum Creek), N. B. Tweet & Sons (Kougarok River), Patrick J. Bliss (Ungalik River), Ralph DeLong (Rock Creek), and Orville J. Dickman (Gold Run Creek).

The Federal Bureau of Mines continued to investigate the lode potential of the tin belt of the western Seward Peninsula. Fieldwork in 1961 included trench sampling of lode outcrops in the Potato Mountain area; work on lode tin in the Tin City area was planned for 1962.

Fieldwork under the Bureau's beryllium program included surface sampling, diamond drilling, and field surveys in which a beryllometer was used to test mineral dikes and beds in the Lost River, Kigluaik Mountain, Fish Creek, and Paragon Mountain areas. Reconnaissance surveys were made at Ear Mountain, Cape Mountain, Potato Mountain, and Brooks Mountain. The Bureau sampled a large beryllium-bearing tactite deposit at the Lost River mine. Preliminary fieldwork in 1959 and 1960 had shown beryllium as chrysoberyl and other beryllium minerals disseminated through the tactite in chrysoberyl-tourmaline-fluorite veinlets.

At the Lost River tin mine, work was confined to rehabilitation and plant improvements; in the 1962 field season, the owners planned stripping and trenching for extension of known veins. Only assessment work was done on the Peninsula's iron, bismuth, graphite, and lead deposits. Some interest was shown in beach sands at Nome and Bluff, but no operations were undertaken.

Southeastern Alaska.—The region ranked sixth in value of mineral production. Sand and gravel, stone, and uranium were the leading mineral commodities; small quantities of gem stones, lead, gold, and silver also were mined.

Exploration of Southeastern's metallic and nonmetallic deposits continued with great activity. Interest in the region's iron resources was particularly strong. Utah Construction and Mining Co. continued fieldwork on the Mount Andrew and Poorman deposits in Kasaan Peninsula, Prince of Wales Island, and on the Ptarmigan Group at North Bradfield River on the mainland southeast of Wrangell. Columbia Iron Mining Co. worked the Union Bay deposit, Cleveland Peninsula, 40 miles northwest of Ketchikan. At Port Snettisham, southeast of Juneau, both Owen Ore Co. and Admiralty-Alaska Gold Mining Co. were actively exploring iron deposits. W. E. Lemke made magnetometer surveys on the Lemke No. 1 iron deposit near Petersburg. Standard Slag had a field crew examining various iron deposits and prospects in the Ketchikan area. The M. A. Hanna Co. fieldman explored prospects in the Wrangell-Ketchikan area and iron deposits near Port Snettisham. Sinclair Oil Co., using a helicopter, did some reconnaissance geological work.

Columbia Iron Mining Co. exercised its option to contract for purchasing the Klukwan placer and lode iron deposits at Klukwan, near Haines and 60 miles north of Juneau. Klukwan Iron Ore Corp., controlled by Quebec Metallurgical Industries (an affiliate of Ventures, Ltd.), was the seller. Columbia had conducted an extensive examination at Klukwan over the past 5 years and using magnetic concentrates produced at Klukwan, had made amenability tests, on samples of large tonnage at plants in the States to the south. The Klukwan deposits were huge but were relatively low grade. United States Steel Corp., parent of Columbia, filed notice of intent to do business within the State and paid $19,105 in registration fees for a business license. At Brady Glacier on the mainland 85 miles west of Juneau, Newmont Exploration, Ltd. (subsidiary of Newmont Mining Co.), continued diamond drilling and geological work on a copper-nickel deposit. Results were said to be favorable enough to warrant further work. Admiralty-Alaska Gold Mining Co. did some diamond drilling and a little underground exploration and sampling on the Mertie lode copper-nickel deposit at Funter Bay. At yearend the company had prepared an application for an Office of Minerals Exploration loan.

Some interest was shown in the gypsum deposits of the region. At yearend plans for examinations of the Gypsum Creek and Gypsum-Camel deposits at Iyoukeen Cove, Chichagof Island were underway. Columbia Iron Mining Co. diamond-drilled limestone deposits on Wadleigh and Heceta Islands. Asbestos deposits (paligorskite) on Lemesurier Island, 60 miles west of Juneau in Cross Sound, drew some interest by mining companies but no examination work was reported. A silica deposit in the Hyder district was under examination; feasibility of shipment to the Pacific Northwest was being studied.

Bay West, Inc., and Shattuck Denn Mining Corp. took over the Ross-Adams uranium property at Bokan Mountain, Prince of Wales Island. The new operators planned to mine both by open-pit and underground methods; some underground exploration and development was done in 1961. Mineral Basin Mining Corp. examined several old producing mines in the Hyder district by several hundred feet of drifting, trenching, and road work. Silver was the metal of prime interest. The district had produced gold, tungsten, and small quantities of base metals.

Kloss and Davis continued to explore their Sunset Cove antimony property. Carl Wikstrom shipped or stockpiled a small quantity of sorted tungsten ore and gravity concentrate from his mine near Hyder. Colorado Oil and Gas Corp. completed four core holes in the Yakutat area in exploratory drilling for petroleum.

Yukon River.—Value of mineral production in the Yukon River region decreased 20 percent from that in 1960 despite a 19-percent increase in the value of coal output. The sharp decline in value resulted largely from lower gold output at the Fairbanks dredge fields. Coal replaced gold as the leading mineral commodity; sand and gravel ranked third. Military contracts for coal, reflecting the activation of the Clear Missile Station southwest of Fairbanks and the reduction of stocks at Eilson Air Force Base and Fort Wainwright, increased 41 percent in volume and 25 percent in value. Two strip mines and one underground mine produced coal during the year. Usibelli Coal Mine, Inc., and Cripple Creek Coal Co. operated strip mines in the Nenana (Healy River) field. Usibelli also operated the Suntrana underground mine steadily throughout the year. Of all coal produced, strip mines furnished 79 percent of both tonnage and value. Average value of the strip coal was $6.68 per ton; of underground coal, $6.77 per ton.

In gold mining, 10 dredges, the same number as in 1960, were active. USSR&M continued as the leading gold producer. It operated four dredges in the Fairbanks field; one, on the Hogatza River, Hughes district; and one, at Chicken, Fortymile district. Toward the end of the 1961 dredge season, USSR&M announced plans to discontinue its Fairbanks operations at the end of the 1963 season. Others mining by dredge were Mathews Mining Co. (Woodchopper Creek), John Stevens (Flat Creek), Miscovich Bros. (Otter Creek), and Minalaska, Inc. (Gaines Creek). Dredges furnished 80 percent of the gold produced.

Nonfloat plants produced 16 percent of the gold. Wolf Creek Mining Co. (Fish Creek, Fairbanks district), Prince Creek Mining Co. (Prince Creek, Iditarod district), Flat Creek Placers (Flat Creek, Iditarod district), Redstone Mine (Livengood Creek, Tolovana district), Spruce Creek Mining Co. (Spruce Creek, Innoko district), and Rosander and Reed (Yankee Creek, Innoko district) were among the leading nonfloat producers.

Small hydraulicking operations were conducted by Stuver Bros. (Moore Creek, Kantishna district), Ruby Mining Co. (Long Creek, Ruby district), Hassel Mining Co. (Ready Bullion Creek, Fairbanks district), and Jens Langlow (Switch Creek, Circle district).

Lode-gold mining remained almost dormant. Arctic Alaska Fisheries and Enterprises produced lode gold from the Kawalita claim in the Fairbanks district. Little Squaw Mining Co. had consolidated lode and placer holdings in the Chandalar district, north of the Arctic Circle, and applied for an OME loan after liberalized provisions—making gold and silver eligible for exploration assistance under the OME program—were announced by the Secretary of the Interior.

In exploration for petroleum, results of geophysical testing of areas south of Fairbanks and east of Nenana were reported to be favorable. After gravity work had been done in this area, Union Oil Co. of California announced plans to drill a slim-hole test southwest of Fairbanks. Investigations in the Porcupine-Kandik Basin were considerably reduced in scope from activity in previous years; one company mapped surface geology; there was no geophysical work.

The U.S. Army Corps of Engineers made engineering studies, including diamond-drill tests of foundations at the site of the proposed Rampart Dam on the Yukon. Development and Resources Corp. of New York under a contract with the Corps of Engineers was studying the probable market for Rampart power. At Fort Greely, construction of the Corps of Engineers nuclear powerplant (SM–IA) was completed, and testing was begun. The plant was designed as a stationary unit for isolated or remote installations. Capacity was rated at 1,640 kilowatts electric net plus 46 million Btu per hour steam for space heat.

The Mineral Industry of Arizona

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Bureau of Mines.

By L. P. Larson[1]

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THE TOTAL value of Arizona mineral production in 1961 was $433 million, an increase of $17 million, or 4 percent, over that reported for 1960. Value of output in 1961 was the highest since 1956, primarily because of increases over 1960 of $6.4 million and $10.5 million in the value of copper and sand and gravel production. Of the total value, metals accounted for 89 percent; nonmetals, 11 percent; and mineral fuels, less than 1 percent.

TABLE 1.—Mineral production in Arizona[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate........short tons, gross weight..	(2)	(2)	8	$4
Clays[3]........thousand short tons..	173	$260	165	240
Coal (bituminous)........do....	6	58	------------	------------
Copper (recoverable content of ores, etc.)...short tons..	538,605	345,784	587,053	352,232
Gem stones........	(4)	120	(4)	119
Gold (recoverable content of ores, etc.)...troy ounces..	143,064	5,007	145,959	5,109
Iron ore (usable)........long tons, gross weight..	------------	------------	246	(2)
Lead (recoverable content of ores, etc.).....short tons..	8,495	1,988	5,937	1,223
Lime........thousand short tons..	148	2,430	167	2,686
Manganese ore and concentrate (35 percent or more Mn)........short tons, gross weight..	1,626	40	(2)	(2)
Manganiferous ore and concentrate (5 to 35 percent Mn) short tons, gross weight..	8,677	190	------------	------------
Mercury........76-pound flasks..	(2)	(2)	148	29
Molybdenum (content of concentrate) thousand pounds..	4,359	5,211	4,878	6,232
Petroleum (crude)........thousand 42-gallon barrels..	73	(2)	[5] 67	(2)
Pumice........thousand short tons..	703	1,164	745	1,893
Sand and gravel........do....	14,490	14,235	21,953	24,706
Silver (recoverable content of ores, etc.) thousand troy ounces..	4,775	4 322	5,120	4,733
Stone........thousand short tons..	4,249	5,107	3 582	4,626
Uranium ore........short tons..	283,684	6,219	228,225	4,965
Zinc (recoverable content of ores, etc.)........do....	35,811	9,239	29,585	6,804
Value of items that cannot be disclosed: Asbestos, cement, clays (bentonite, fire clay 1961), diatomite (1961), feldspar, gypsum, helium (1961), mica (scrap), perlite, pyrites, tungsten concentrate (1960), vanadium, and values indicated by footnote 2........	------------	[6] 15,851	------------	18,910
Total Arizona[7]........	------------	[6] 415,512	------------	432,614

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Excludes bentonite and fire clay (1961); included with "Value of items that cannot be disclosed."
[4] Weight not recorded.
[5] Preliminary figure.
[6] Revised figure.
[7] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

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The value of metals production was up primarily because of the rise in output of copper and associated byproduct metals, molybdenum, silver, and gold. The quantity and value of lead, manganese, tungsten, uranium, vanadium, and zinc decreased. A strike called by the International Association of Machinists idled the Inspiration mine from September 27 through October 22. Loss of production resulting from the strike was more than offset by output from the Mission Unit, 15 miles southwest of Tucson, operated by American Smelting and Refining Company (Asarco).

Sand and gravel output ranked second in value and accounted for 6 percent of Arizona's total mineral production value. It accounted for 50 percent of the value of all nonmetals produced. Output of cement rose 26 percent.

Employment and Injuries.—Final data for 1960 and preliminary data for 1961 compiled by the Bureau of Mines for employment and injuries in the Arizona mineral industries, excluding the petroleum industry, are shown in table 2.

Legislation and Government Programs.—No Office of Mineral Exploration (OME) contracts were executed in Arizona during 1961. The Federal Bureau of Land Management ruled that the 47 Association placer claims in the Casas Adobes area near Tucson did not have a valid mineral discovery. These claims, in a residential area, were issued patents for the surface rights under the Homestead Grazing Act of 1916, but the mineral rights were reserved to the Government.

TABLE 2.—Employment and injuries in the mineral industries [1]

Industry	Number of operations [2]	Average number of men employed	Total man-hours worked	Injuries: Fatal	Injuries: Nonfatal	Frequency rate (injuries per million man-hours)
1960:						
Copper mines and mills	140	9,400	22,449,515	11	484	22.0
Copper smelters and refinery	9	2,120	5,308,248	1	92	17.5
Uranium mines and mills	48	434	892,118	1	46	52.7
Other metal mines and mills	54	455	939,108	3	112	122.5
Nonmetal mines and mills (other than sand and gravel and stone)	47	394	831,827		18	21.6
Stone quarries and plants	71	538	1,222,851		36	29.4
Sand and gravel plants	70	1,270	2,306,118	2	58	26.0
Coal mines	2	18	21,712			
Total	441	14,629	33,971,497	18	846	25.4
1961: [3]						
Copper mines and mills	134	9,579	22,887,803	7	461	20.4
Copper smelters and refinery	9	1,950	5,155,948	1	136	26.6
Uranium mines and mills	28	328	673,821		44	65.3
Other metal mines and mills	86	537	868,430		126	145.1
Nonmetal mines and mills (other than sand and gravel and stone)	45	183	316,546		10	31.6
Stone quarries and plants	71	562	1,138,562		13	11.4
Sand and gravel plants	143	1,685	3,116,120		28	9.0
Coal mines	1	4	3,200			
Total	517	14,828	34,160,430	8	818	24.2

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Preliminary figures.

An act providing for prospecting permits and mineral leases on State lands in Arizona became effective March 15.

Duval Sulphur & Potash Co. patented 1 group of 89 lode claims totaling 1,729 acres under a single patent. A second tract of 41 claims totaling 771.5 acres was patented by Kennecott Copper Corp. in the *Lone Star* mining district near Safford.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—A small quantity of 10-percent beryllium oxide concentrate was recovered from the Homestead lode by Earl F. Anderson and from the Outpost property by V. R. Denning. Both properties are in Yavapai County.

Copper.—The copper industry, which opened the year on a pessimistic note, went on to achieve a record year for the output of primary copper. Early in the year several producers curtailed operations shortly after the domestic price of copper was reduced from 30 cents to 29 cents per pound on January 17. With the reduction of stocks in the second quarter, production was increased and by the end of the year the industry was producing at capacity. Curtailment in the first several months, vacations in June and July, and the September 27 to October 22 strike at Inspiration resulted in overall below-capacity production of copper but even so production was up 9 percent in quantity and 2 percent in value, compared with that of 1960. Completion of the Mission Unit by Asarco near Tucson was the main reason for the increase. Copper was 92 percent of the value of metals and 81 percent of the State value of all minerals produced.

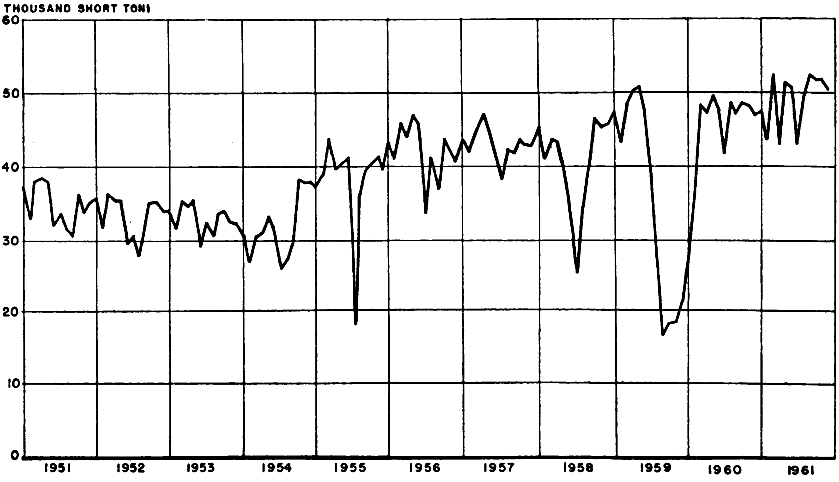

Figure 1.—Mine production of copper in Arizona, 1951–61, by months, in terms of recoverable metal.

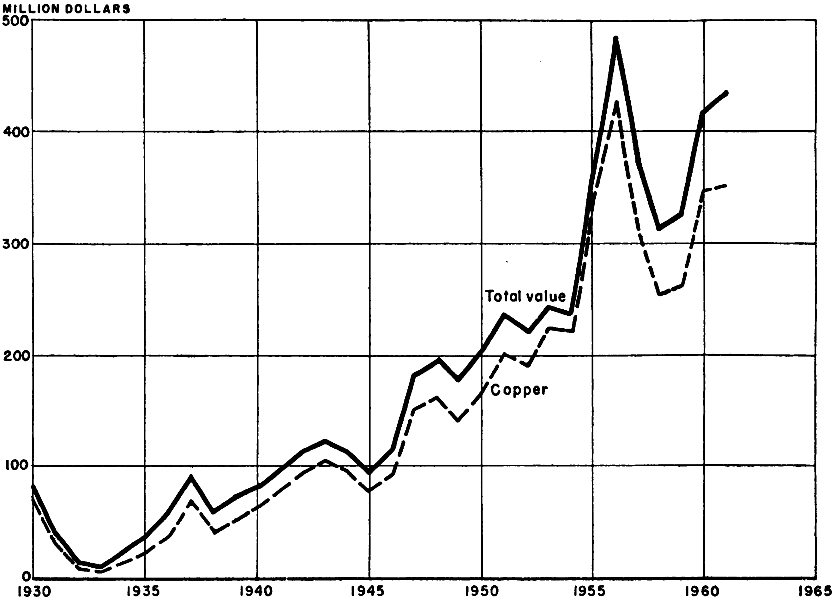

FIGURE 2.—Value of mine production of copper and total value of mineral production in Arizona, 1930–61.

TABLE 3.—Fifteen leading copper-producing mines in 1961, in order of output

Rank in 1961	Rank in 1960	Mine	District	County	Operator	Source of copper in 1961
1	1	Morenci	Copper Mountain.	Greenlee	Phelps Dodge Corp.	Gold-silver ore, copper ore, copper precipitates.
2	2	San Manuel	Pioneer	Pinal	San Manuel Copper Corp.	Copper ore.
3	3	New Cornelia	Ajo	Pima	Phelps Dodge Corp.	Gold ore, gold-silver tailings, copper ore.
4	4	Lavender pit, Copper Queen.	Warren	Cochise	do	Copper ore, copper precipitates.
5	5	Ray pit	Mineral Creek	Pinal	Kennecott Copper Corp.	Do.
6	6	Inspiration	Gila	Gila	Inspiration Consolidated Copper Co.	Do.
7	7	Esperanza	Pima	Pima	Duval Sulphur & Potash Co.	Copper ore.
8	8	Silver Bell Unit.	Silver Bell	do	American Smelting and Refining Co.	Copper ore, copper precipitates.
9	9	Magma	Pioneer	Pinal	Magma Copper Co.	Gold-silver ore, copper ore.
10	10	Copper Cities	Globe-Miami	Gila	Tennessee Corp. Miami Copper Co. Div.	Copper ore.
11	11	Pima	Pima	Pima	Pima Mining Co	Do.
12	------	Mission Unit	do	do	American Smelting and Refining Co.	Do.
13	12	Bagdad	Eureka	Yavapai	Bagdad Copper Corp.	Copper ore, copper precipitates.
14	13	Miami	Globe-Miami	Gila	Tennessee Corp. Miami Copper Co. Div.	Copper precipitates.
15	------	Palo Verde	Pima	Pima	Banner Mining Co	Copper ore.

TABLE 4.—Ore mined, waste and leach material removed, and total copper production at principal copper open-pit and underground mines

(Short tons)

Mine	Ore mined		Waste and leach material removed		Total copper produced from all sources[1]	
	1960	1961	1960	1961	1960	1961
Open pit:						
Morenci	14,500,000	16,286,000	21,200,000	27,174,000	105,640	111,443
New Cornelia	9,066,000	9,358,000	14,700,000	14,692,000	66,693	70,334
Ray	6,526,814	7,428,104	[2] 14,467,527	[2] 15,491,623	58,799	64,170
Lavender	4,245,000	4,928,000	11,572,000	13,647,000	33,248	39,585
Inspiration	5,314,770	4,847,164	4,105,835	3,447,947	40,400	39,165
Esperanza[2]	4,245,762	4,188,775	9,648,961	----------	(3)	(3)
Silver Bell[2]	2,723,200	2,686,800	1,788,470	978,670	(3)	(3)
Copper Cities	[2] 3,058,372	[2] 3,137,253	[2] 1,666,149	[2] 1,562,927	16,551	17,336
Pima	1,327,473	1,398,367	[2] [4] 4,602,016	[2] [4] 5,361,053	(3)	(3)
Mission Unit[2]	----------	2,198,585	29,669,400	23,570,700	----------	(3)
Bagdad	[2] 1,868,668	[2] 1,807,260	[2] 6,006,118	[2] 7,174,630	[5] 11,931	[5] 10,970
Underground:						
San Manuel	12,261,220	12,529,243	----------	----------	81,724	82,612
Copper Queen	509,700	595,000	----------	----------	25,575	30,398
Magma	386,636	410,958	----------	----------	18,917	20,761
Miami	(6)	(6)	----------	----------	9,390	9,429
Palo Verde	6,852	158,546	----------	----------	(3)	(3)

[1] Includes copper recovered from leaching of material in place and in dumps.
[2] Mining World Catalog, Survey and Directory, Apr. 25, 1962, p. 95.
[3] Figure withheld to avoid disclosing company confidential data.
[4] Cubic yards.
[5] Gross metal in concentrate shipped.
[6] All production from in-place leaching.

Source: Company-published annual reports except where otherwise specified.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1952-56 (average)	176	6	49,660	122,743	$4,296	4,633	$4,193
1957	141	8	60,166	152,449	5,336	5,279	4,778
1958	100	4	56,773	142,979	5,004	4,685	4,240
1959	101	3	53,732	124,627	4,362	3,898	3,528
1960	106	5	66,800	143,064	5,007	4,775	4,322
1961	96	4	72,537	145,959	5,109	5,120	4,733
1860-1961	----------	----------	(3)	12,739,697	333,385	364,434	282,298

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	425,437	$281,834	11,230	$3,356	28,880	$7,842	$301,521
1957	515,854	310,544	12,441	3,558	33,905	7,866	332,082
1958	485,839	255,551	11,890	2,782	28,532	5,821	273,398
1959	430,297	264,202	9,999	2,300	37,325	8,585	282,977
1960	538,605	345,784	8,495	1,988	35,811	9,239	366,340
1961	587,053	352,232	5,937	1,223	29,585	6,804	370,101
1860-1961	17,782,444	7,073,881	614,778	119,673	880,285	212,602	8,021,839

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Data not available.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing[1]		Material sold or treated[2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Cochise	6	--------	5,647,412	50,310	$1,760,850	897,032	$829,297
Coconino	2	--------	2,003	--------	--------	539	498
Gila	13	1	8,049,633	1,506	52,710	147,642	136,494
Graham	1	--------	5	--------	--------	14	13
Greenlee	1	--------	16,285,698	9,685	338,975	685,028	633,302
Maricopa	5	1	301	87	3,045	178	165
Mohave	4	--------	2,821	193	6,755	2,604	2,407
Navajo	--------	--------	(3)	--------	--------	1,798	1,662
Pima	12	--------	19,986,671	35,375	1,238,125	1,489,973	1,377,465
Pinal	17	--------	20,410,240	33,508	1,172,780	1,137,713	1,051,804
Santa Cruz	6	--------	24,596	51	1,785	57,394	53,060
Yavapai	22	--------	2,127,627	15,180	531,300	699,922	647,071
Yuma	7	2	167	64	2,240	170	157
Total:							
1961	96	4	72,537,174	145,959	5,108,565	5,120,007	4,733,395
1960	106	5	66,800,315	143,064	5,007,240	4,774,992	4,321,609

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Cochise	71,746	$43,047,390	26	$5,387	2,842	$653,522	$46,296,446
Coconino	13	7,980	--------	--------	--------	--------	8,478
Gila	68,939	41,363,190	6	1,174	5	1,092	41,554,660
Graham	(4)	180	--------	--------	--------	--------	193
Greenlee	111,443	66,865,800	--------	--------	--------	--------	67,838,077
Maricopa	9	5,610	--------	--------	--------	--------	8,820
Mohave	34	20,670	2	464	19	4,393	34,689
Navajo	177	106,350	(4)	10	(4)	92	108,114
Pima	151,612	90,966,450	(4)	103	2,433	559,659	94,141,802
Pinal	167,298	100,378,770	2	494	(4)	35	102,603,883
Santa Cruz	54	32,250	985	202,859	1,505	346,173	636,127
Yavapai	15,727	9,436,410	4,911	1,011,604	22,781	5,239,538	16,865,923
Yuma	1	750	5	927	(4)	46	4,120
Total:							
1961	587,053	352,231,800	5,937	1,223,022	29,585	6,804,550	370,101,332
1960	538,605	345,784,410	8,495	1,987,830	35,811	9,239,238	366,340,327

[1] Operations at miscellaneous cleanups not counted as a producing mine.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Byproduct of uranium ore.
[4] Less than 0.5 ton.

Copper output declined from 47,000 tons in January to 44,000 tons in February, rose to 52,000 tons in March, dropped to 43,000 tons in April, and increased to 51,000 tons in May and June. Owing to vacations, output again was reduced to 43,000 tons in July. It was 50,000 tons in August, and 52,000 tons in September. During the fourth quarter, production declined to 50,400 tons in December, averaging 51,268 tons for the quarter.

The 5 leading operations furnished 398,542 tons, or 68 percent, and the top 15 accounted for 576,827 tons, or 98 percent of the copper output. Phelps Dodge Corp. operated three of the five largest mines; one was operated by San Manuel Copper Corp., and one by Ray Mines Division, Kennecott Copper Corp.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	16	30,450	610	4,901	336,400	6,300	8,300
Dry gold-silver	5	104.447	277	13,197	1,969.600	------	------
Dry silver	11	15,456	13	16,339	67,500	------	------
Total	32	150,353	900	34,437	2,373,500	6,300	8,300
Copper	43	71,918,991	129,184	4,380,455	1,092,360,900	1,000	449,600
Copper-zinc	4	156,824	95	52,431	9,044.400	5.600	19,183,400
Lead	6	1,250	34	6.367	3,900	148,700	9.800
Lead-zinc	10	260,547	14,731	627,644	634,600	11,701,200	35,095,900
Zinc	2	15,059	------	654	46.600	------	4,419,100
Total	64	72,352,671	144,044	5,067,551	1,102,090,400	11,856.500	59,157,800
Other "lode" material:							
Gold mill cleanup	(2)	(3)	197	113	------	------	------
Gold-silver and silver tailings	4	29,217	599	10,241	92,000	900	------
Copper cleanup	(2)	763	6	955	198,700	------	1,800
Copper smelter cleanup	(2)	2,180	105	4,423	275,400	2,700	1,300
Copper precipitates	11	46,861	------	------	68,698,300	------	------
Copper tailings	1	1,982	------	481	23,200	------	------
Lead cleanup	(2)	6	------	1	------	4,100	------
Lead smelter cleanup	(2)	2	------	4	------	3,400	------
Uranium ore	------	------	------	1,798	354,500	100	800
Total	16	81,011	907	18,016	69,642,100	11,200	3,900
Total "lode" material	100	72,584,035	145,851	5,120,004	1,174,106,000	11,874,000	59,170,000
Gravel (placer operations)	4	------	108	3	------	------	------
Total, all sources	104	72,584,035	145,959	5,120,007	1,174,106,000	11,874,000	59,170,000

[1] Detail will not necessarily add to totals because some mines produce more than 1 class of material.
[2] From properties not classed as mines.
[3] Less than 0.5 ton.

Research and development on leaching copper from mine waste by Kennecott Copper Corp. were intensified during the year. As a result of the joint efforts of research, engineering, and operating personnel, an increased quantity of copper was recovered by leaching. Methods to produce iron for use in precipitating copper from solution were being developed, and procedures to improve iron utilization were under study. These and other studies were directed toward further increasing copper recovered by leaching. Pilot plant studies utilizing oxygen in smelting concentrates were continued in 1961 and data were processed and evaluated. Investigations and pilot plant operations to process electrolytic tankhouse slimes, in an effort to improve byproduct metal recovery and to lower processing costs, were well advanced.

Bear Creek Mining Co., exploration subsidiary of Kennecott Copper Corp., prospected by diamond drilling in the Sierritas-Twin Buttes (Pima County), Copper Creek (Pinal County), and Courtland-Gleeson (Cochise County) areas.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in 1961, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation: Ore	215	120	------	------	------
Cyanidation: Ore	922	9,521	------	------	------
Total recoverable in bullion	1,137	9,641	------	------	------
Concentration and smelting of concentrates:					
Ore [1]	112,779	4,536,979	[2] 1,056,443,300	11,784,500	59,144,500
Old tailings	15	926	23,200	900	------
Total	112,794	4,537,905	1,056,466,500	11,785,400	59,144,500
Direct-smelting:					
Ore	31,225	557,279	48,375,100	78,400	22,400
Cleanings	111	5,383	474,100	10,200	3,100
Copper precipitates	------	------	68,698,300	------	------
Old tailings	584	9,796	92,000	------	------
Total	31,920	572,458	117,639,500	88,600	25,500
Placer	108	3	------	------	------
Grand total	145,959	5,120,007	1,174,106,000	11,874,000	59,170,000

[1] Includes uranium ore concentrate.

[2] Includes copper recovered from leaching of ore at one operation that employs dual-process treatment of leaching followed by flotation concentration; combined to avoid disclosing individual company confidential data.

Inspiration Consolidated Copper Co. completed the McDonald shaft at the Christmas mine to a depth of 1,793 feet in April. In addition, 7,281 feet of drifts, raises, and miscellaneous excavations were driven. Working conditions were greatly improved on completion of the No. 6 ventilation shaft to the 1,600-foot level and the installation of additional pumping equipment. Construction of facilities for crushing, conveying, and concentrating ore was nearly completed. Tailings dams were laid out and initial berms were constructed. Installation of equipment required for transporting concentrates at the new plant and at the Inspiration smelter continued. Underground work concentrated upon preparation of the property for production. According to the company annual stockholders' report, no additional reserves of ore were developed; reserves of ore remained at 20,061,625 tons of proven and probable ore, averaging 1.83 percent copper. The ore had an estimated recoverable copper content of 660 million pounds.

Inspiration also disclosed in its annual report that the large tonnage of generally low-grade material north of the Live Oak pit was augmented by development drilling in the eastern section of the area. If drilling in the remaining part of this section confirms expectations, approximately 24 million tons of ore containing 0.62 percent copper will be available in addition to the higher grade reserves in the Live Oak and Thornton pits. The proposed new Red Hill Sunset mine was expected to have a stripping ratio of less than 2 to 1.

Phelps Dodge Corp. exercised options to purchase 299 unpatented mining claims near Safford. The large low-grade deposit within the area covered by the claims was not expected to be developed for many years. Copper production by the company in 1961 was 253,000 tons, an increase of 19,000 tons over 1960, and the third largest production in the company's history.

A 25-ton-per-day sponge iron plant was built at the Douglas smelter, and put into operation late in the year. Sponge iron, produced at the plant, was made from iron oxides recovered from the smelting process. A new process developed at the Douglas smelter for removing oxygen from copper in the anode furnace by reformed natural gas instead of wood poles was installed at the Morenci and Ajo smelters. At Morenci, large-scale metallurgical testing was performed on two separate processes for the recovery of small amounts of copper present in oxide form in the sulfide ores treated at the concentrator. Tests on one of the processes were discontinued, pending further laboratory study. Operating schedules were about 5¾ days per week until late September, when full production (6½ days per week at open-pit mines and 6 days per week at underground mines) was resumed. Operations at Morenci, Ajo, Bisbee, and Douglas were normal during the year. No labor agreements expired at the company mining properties or refineries, and there were no reopening provisions under existing agreements.

Duval Sulphur & Potash Co. continued exploration drilling at the Mineral Park copper-molybdenum property. Near the end of the year the company began close-pattern drilling and underground development. This work will provide detailed information required for the development of a plan for stripping and mining the mineral deposit. The underground development will verify drill-hole results, provide material for metallurgical testing, and determine the continuity of the deposit. Mineral rights were held by the company under patented and leased mining claims. Investigations showed that the deposit was a quartz monzonite stock, mineralized with pyrite and chalcopyrite, with shear zones showing extensive copper mineralization.

Installation of copper leach-precipitation facilities to produce copper from several mine dumps at the Esperanza mine was commenced by Duval Sulphur & Potash Co. The leaching and precipitation facilities, of conventional design, were to be completed early in 1962. According to the company annual report, development drilling of outlying areas of the Esperanza mine disclosed substantial copper-molybdenum ore reserves immediately west of the present pit. Mineralization in this area is similar to that of the main Esperanza ore body. Reserves in the new area exceeded the total ore mined to date at Esperanza. The additional ore, when developed, was to be processed at the Esperanza mill.

Asarco modernized its Hayden smelter to treat copper concentrates from the Mission operation. According to the company annual report, the Mission mill, designed for a daily capacity of 15,000 tons of ore, began operating in August, reached rated capacity during September, and continued to operate throughout the rest of the year. The company expected that the grade of ore mined at Mission during the early operations would be somewhat lower than the average grade of the ore body. Before milling began, 46.4 million tons of material was removed from the pit, of which 1.2 million tons was ore stockpiled for future treatment. The program was completed about 6 months ahead of schedule, at just over $33 million, well below the $43.5

million originally estimated. Copper recovery from concentrates produced was estimated to be approximately 45,000 tons per year.

Proven ore reserves at the Pima mine were estimated at 7.2 million tons, containing 1.51 percent copper, according to the Cyprus Mines Corp. annual report. These reserves excluded 1.8 million tons of ore from the adjacent Banner Mining Co. that was to be mined and treated by Pima under a custom mining and milling agreement. Cyprus Mines approved plans for an expansion program to increase the mining rate and milling capacity from 3,800 to 7,000 tons per day. The expansion would permit the company to mine large low-grade ore reserves east and northeast of the present pit, thus extending the life of the mine for many years.

Magma Copper Co. acquired 12 patented and 112 unpatented mining claims contiguous to and south of its property from Belmont Copper Mining Co. The claims adjoin 50 claims optioned to Magma in 1958 by Queen Creek Copper Co. The combined Belmont and Queen Creek properties cover 3.5 square miles.

Bagdad Copper Corp. produced the first cement copper at its $2 million leaching plant adjacent to the company open-pit copper mine at Bagdad, Yavapai County, on April 26. According to the company report, problems encountered in pumping and drying cement copper after it was precipitated reduced recovered values below expectations. Copper recovered per gallon of solution was less than one-half that anticipated. Production at yearend was only 10 to 15 percent of the expected 20 tons per day.

According to the Banner Mining Co. annual report to stockholders, drilling on a group of State-leased claims near its Palo Verde mine increased the indicated ore reserve held by the company in the immediate area to 64 million tons. This represented an increase of 10 percent over the reserve held in 1960. Considerable drilling was necessary to evaluate the deposit but plans were being made to develop the property. Other exploration by the company included examinations in the *Helvetia* district and in the Twin Buttes area.

A patent assigned to Banner Mining Co. covered a method of extracting copper and preparing an electrolyte from oxidized copper ore particles containing substantial quantities of chrysocolla. The process consisted of leaching the ore particles with a 5 to 10 normal solution of sodium hydroxide and potassium hydroxide. The ore was unsuitable for acid leaching because of the presence of calcium and/or manganese carbonates.

The installation of two new furnaces and coolers was expected to increase the capacity of the Lakeshore copper mill of Transarizona Resources, Inc., from 250 to 750 tons per day.

A new 6- by 9-foot vertical shaft 500 to 600 feet deep was sunk at the Atlas mine in the *Silver Bell* district by B.S. & K. Mining Co.

Strong & Harris, Inc., continued open-pit mining of highly siliceous ore at the Burro claims in the *Johnson* district, Cochise County, and shipped from 5,000 to 5,500 tons per month to the Phelps Dodge Corp. Douglas smelter for use as a flux.

Gold.—Output of gold totaled 145,959 ounces, 2 percent more than in 1960. Eighty-nine percent was recovered as a byproduct in the refining of copper; 1 percent was recovered from gold and silver ores;

and the remaining 10 percent was recovered chiefly from lead-zinc ores. The major mining operations, listed in order of output, were Copper Queen, New Cornelia, San Manuel, Iron King, Magma, Morenci, Ray Pit, and Copper Cities. The first three produced 70 percent of the State output; the next five, 28 percent.

Cochise was the leading gold-producing county.

According to the annual report of Magma Copper Co., production of gold at the San Manuel Copper Corp. San Manuel mine declined from 18,010 ounces in 1960 to 17,597 ounces, whereas output at the Magma mine increased from 14,374 ounces in 1960 to 14,641 ounces. Total production of gold by the company declined only 146 ounces, or less than 1 percent. The increased output from the Magma mine during the year was due to the increased tonnage of ore milled, because the gold content of the ore dropped to 0.036 ounce per ton, compared with 0.04 ounce in 1960.

In its annual report to the shareholders, Phelps Dodge Corp., reported that the combined output of gold recovered as a byproduct of copper mining at the Morenci, New Cornelia, and Copper Queen Branches increased from 82,000 ounces in 1960 to 94,000 ounces.

Iron and Steel.—George B. Smith Chemical Works, operator of the Sally mine in Mohave County, was the only producer of hematite ore in the State. Magnetite ore was produced by H. M. Seitz, operator of the Margaret/Howard mine, Gila County.

Exploration for iron and other minerals on 120,200 acres (188 square miles) of the northwestern section of the Fort Apache Indian Reservation by The Colorado Fuel and Iron Corp. proceeded on schedule. A number of access roads were being completed. Detailed mapping of some areas was in progress. The company reported that diamond drilling pierced through the ore horizon in two places.

Ray Mines Division, Kennecott Copper Corp., produced sinter (sponge iron) and sulfuric acid from pyrite recovered as a byproduct from the Hayden mill, and from pyrite purchased at Magma. The finely divided (minus 35-mesh) sponge iron was used in the leach-precipitation-flotation (LPF) process employed at the Hayden copper ore concentrator, and the sulfuric acid was used in leaching mine dump material and ore in place in worked-out areas of the old underground Ray mine.

Phelps Dodge Corp. completed construction of a 25-ton-per-day sponge iron plant at the Douglas smelter and began operation in the latter part of the year. The sponge iron, made from iron oxides produced during the smelting process, was expected to be a more economical precipitant for copper than the purchased detinned cans used in leaching at Bisbee.

Arkota Steel Co. dedicated its new $1 million steel plant near Coolidge in December. The company utilized the J. D. Madaras reduction process to produce high-grade iron from magnetite. The sands were to be upgraded to 50 percent iron by magnetic separation.

Lead.—Lead production was 30 percent lower in quantity and 38 percent lower in value than in 1960. Most of the production came from lead-zinc ores produced at the Iron King mine by Shattuck Denn Mining Corp. Nash & McFarland, the State's second largest producer, operated the Flux mine in Santa Cruz County. These mines accounted for 98 percent of the lead produced in the State.

Manganese Ore and Concentrate.—Thunderbird Metallurgical, Inc., recovered manganese concentrate at the Ambrosia mill near Aguila, using Humphrey spirals and alluviators (hydraulic sorting columns) to treat jig tailings. Four hundred to 500 tons of material was handled daily. Heads contained 5 to 8 percent manganese; the concentrate averaged 41 percent. The concentrate was shipped to Henderson, Nev., for conversion to electrolytic manganese dioxide, and to Mexican Hat, Utah, for use as an oxidant in processing uranium ore. Century Mining Co. was reported to have a manganese mill under construction 2 miles southwest of Bouse to treat ores from the Black Mule East and Black Mule West mines. A Bureau of Mines publication[2] described all known manganese deposits in nine eastern Arizona counties.

Mercury.—Production of mercury from mines in the Mazatzal Mountains of Gila and Maricopa Counties increased compared with that of 1960. The Pine Mountain mine (Turnbull claims) in Maricopa County, *Sunflower* mining district, operated by Bacon, Grimes & Brunson, was the largest producer. Second in order of production was the Ord mine in Gila County, also in the *Sunflower* district, operated by James T. McFarland. These two mines were followed in order of production by the National mine, operated by Thomas E. Bolick, in Maricopa County, and the Rattlesnake mine in Gila County, operated by Gus Packard. The Oneida mine in Maricopa County was closed. On a weighted-average basis, the ore produced in 1961 contained 0.23 percent mercury.

Molybdenum.—Output of molybdenum, all recovered as a byproduct in the milling of copper ore, increased 12 percent from 4.4 million pounds in 1960 to 4.9 million pounds. The rise was due to increased output at several of the larger properties. Entrance of D.M.B.D. Mining Co., Inc., into the industry in June did not materially affect the change in output. Shipments of molybdenum totaled 4.9 million pounds valued at $6.2 million, compared with 4.4 million pounds valued at $5.2 million in 1960. The substantial price increase for molybdenum that became effective in June was mainly responsible for the 20-percent increase in the value of shipments, as the tonnage shipped increased only 12 percent in the corresponding period. Uses for molybdenum remained about the same, 85 percent for iron and steel; 15 percent for nonferrous alloys, chemical products, lubrication, and as a metal. Exports accounted for 618,000 pounds, or 13 percent, of the total shipments. Stocks on hand December 31 totaled 80,813 pounds, 90,944 pounds less than reported in 1960. Listed in order of production, the mines and operators were San Manuel, San Manuel Copper Corp.; Esperanza, Duval Sulphur & Potash Co.; Morenci, Phelps Dodge Corp.; Silver Bell, Asarco; Inspiration, Inspiration Consolidated Copper Co.; Bagdad, Bagdad Copper Corp.; and Childs-Aldwinkle, D.M.B.D. Mining Co., Inc.

Molybdenum was produced at Inspiration by the re-treatment of copper concentrates. Metallurgical problems hampered satisfactory recovery. To improve recovery of byproduct molybdenum, a new addition to the molybdenum section of the Silver Bell mill operated by Asarco was under construction. D.M.B.D. Mining Co., Inc., constructed a new 60-ton flotation mill to treat molybdenum-bearing copper ores from the Childs-Aldwinkle mine. Duval Sulphur & Potash Co. produced molybdic trioxide at the Esperanza mill southwest of Tucson. Recovery was at the high rate established in 1960; production increased in 1961 as a result of an increase in the molybdenum content of the copper ore.

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[2] Farnham, L. L., L. A. Stewart, and C. W. DeLong. Manganese Deposits of Eastern Arizona. BuMines Inf. Circ. 7990, 1961, 178 pp.

Silver.—Silver production increased 7 percent in quantity and 10 percent in value over 1960 primarily because of the increased output of copper. The leading silver-producing mines in the State were Copper Queen, Morenci, Magma, Iron King, New Cornelia, San Manuel, Mission, Pima, Ray Pit, Esperanza, Silver Bell Unit, Palo Verde, Inspiration, Bagdad, Copper Cities, Flux, Old Dick, and Johnson Camp.

Uranium.—Uranium ore was produced at 42 operations in Apache, Coconino, and Navajo Counties, compared with 64 operations in 5 counties in 1960. Shipments of uranium ore totaled 228,225 short tons valued at $5 million, a 20-percent decline in quantity and value from 1960. The grade approximated that of the ore produced during 1960. About 87 percent of the ore for the Tuba City mill operated by Rare Metals Corporation of America, came from the Orphan mine on the south rim of the Grand Canyon operated by Western Equities, Inc., formerly Western Gold and Uranium, Inc. The mine produced about 7,000 tons of ore per month. Rare Metals planned to add a carbonate leach circuit to its Tuba City uranium mill to reduce milling costs. Industrial Uranium Corp. reported the discovery of a large uranium ore body at its South Sunlight mine in Monument Valley. In April the company began driving a vertical shaft to mine an ore body of 20,000 tons at this property.

TABLE 9.—Mine production of uranium ore, by counties[1]

County	1960				1961			
	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value[2]	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value[2]
Apache	19	108,835	544,279	$2,272,187	16	89,421	448,032	$1,850,395
Cochise	1	15	42	118	----------	----------	----------	----------
Coconino	30	90,931	522,602	2,211,835	17	76,701	422,928	1,780,188
Gila	4	2,103	14,966	65,448	----------	----------	----------	----------
Navajo	10	81,800	405,528	1,669,840	9	62,103	319,337	1,333,922
Total	64	283,684	1,487,417	6,219,428	42	228,225	1,190,297	4,964,505

[1] Based on data supplied to the Bureau of Mines by AEC.
[2] F.o.b. mine value; base price, grade premiums, and exploration allowance.

Vanadium.—Vanadium was recovered from uranium ores produced in Apache, Coconino, and Navajo Counties at vanadium recovery units operated by Climax Uranium Co., Climax Division, American Metal Climax, Inc., at Grand Junction, Colo.; Vanadium Corporation of America (VCA) at Durango, Colo.; and Kerr-McGee Oil Industries, Inc., at Shiprock, N. Mex. The quantity of vanadium recovered was slightly below that of 1960.

Zinc.—Shattuck Denn Mining Corp. was the State's largest producer of zinc, from its Iron King mine near Humboldt. Exploration and development of the mineralized zone near and parallel to the main ore vein system in the Iron King mine was continued and the company obtained rights to explore, develop, and mine in the area north of and adjoining the mine. Exploration in this area was to be conducted from the lower mine levels. The company was developing new products utilizing the iron and sulfur content of mill tailings. One product, an agricultural soil supplement, was to be produced at a pilot plant constructed to test the process on a commercial basis.

NONMETALS

Asbestos.—Shipments of asbestos from four underground operations in Gila County increased 30 percent in quantity and 44 percent in value over those in 1960. Only a small quantity of Nos. 1 and 2 grade material was produced, the majority of the material being grade Nos. 4 to 7. Prices ranged from $10 per ton for chrysotile waste to $400 per ton for filter-grade material. Producers in order of output were Jaquays Mining Corp. (Regal and Chrysotile mines); Metate Asbestos Corp. (Metate group); and Phillips Asbestos Mines (Phillips mines).

Cement.—In July Phoenix Cement Co. Division, American Cement Corp., completed a third 12- by 10- by 350-foot kiln at its Clarkdale plant. The new kiln, which increased the capacity of the plant by 800,000 barrels to 2.6 million barrels, was primarily responsible for a 26-percent rise in output of cement in Arizona during the year. In July the company delivered the millionth barrel of cement to the Glen Canyon dam construction site, representing the completion of the first one-third of its contract. The first load was shipped on February 8, 1960. The one-way truck haul from Clarkdale to Glen Canyon damsite is 188 miles.

Clays.—Output of all types of clay sold or used increased 3 percent over 1960. A gain in bentonite output and additional production contributed by American Cement Corp., Phoenix Cement Co. Division, a new producer of miscellaneous clay, accounted for the increased output. Bentonite (a nonswelling type) accounted for 16 percent of the total output and 41 percent of the total value. Except for a small quantity of fire clay produced in Gila County, miscellaneous clay accounted for the balance of the production. Gila Arts (formerly Gila Pottery Co.) re-entered business.

Diatomite.—American Diatom, Inc., produced crude diatomite from the White Cliffs mine near Mammoth for use as a filler. Phoenix Gems, Inc., operated a property near San Manuel, producing diatomite for use in the manufacture of insecticides. Both properties are in Pinal County.

Feldspar.—Feldspar production from the Taylor mine in Mohave County, operated by Jerry Haynes for International Minerals & Chemical Corp. (IMC), declined 14 percent from 1960. The entire output was ground at the IMC Kingman mill, and sold or used for the manufacture of glass, pottery, and enamels. The bulk of the material was shipped to California, although some shipments were made to Colorado, Hawaii, Ohio, Pennsylvania, Texas, Washington, and Mexico.

Gem Stones.—The value of gem and ornamental stones collected was $119,000, compared with $120,000 in 1960. Gem and ornamental stones were reported in 14 counties, of which Gila had the greatest output. Yavapai ranked second, followed by Maricopa, Mohave, Yuma, Greenlee, Pima, Navajo, and Pinal. In terms of value, turquoise was the most important stone collected.

Gypsum.—Gypsum was produced at three mines, two in Pinal County and one in Yavapai County. Arizona Gypsum Corp. operated two properties, one in Pinal County near Winkelman, and one in Yavapai County near Camp Verde. The Camp Verde property was acquired by merger with Verde Gypsum Co. in 1960. Output from the two properties was sold uncalcined for cement retarder and for agricultural purposes. National Gypsum Co. operated a mine near Winkelman and calcined the crude gypsum for use in the manufacture of wallboard and lath at the company-owned plant in Phoenix. No production was reported from mines previously operated by Garcia & Peters Gypsum Co.

Lime.—Lime sold or used rose to 167,000 short tons, a 13-percent increase over 1960. Six lime-burning plants operated during the year, compared with five in 1960. The new plant of Ray Mines Division, Kennecott Copper Corp., at Hayden, accounted for most of the increase. Lime used in the concentration of copper ores accounted for approximately 85 percent of all lime sold or used. Requirements ranged from 6 to 10 pounds per ton of mill feed, depending on the oxidation in the low-grade copper ore. A small quantity of lime was used by the construction and agricultural industries. About 10 percent of the output was shipped to California, New Mexico, and Mexico.

Mica.—A small quantity of scrap mica was produced by Buckeye Mica Co. from its Buckeye mine, Maricopa County. The mica was sold mainly for use in the manufacture of roofing materials; a small quantity was sold for use in paints. Los Angeles and the Pacific coast were the main market areas. The Quartzite mine operated by Buckeye Mica Co. in 1960 was reported sold; no production was reported from this property in 1961.

Perlite.—Production and shipments of perlite were lower than in 1960. Both Arizona Perlite Roofs, Inc., and Harborlite Corp. produced less perlite in 1961 than in 1960. The Supreme Perlite, Inc., Phoenix plant produced expanded perlite for use in building plasters. The average value of crude perlite ranged from $6 to about $9 per ton. Weighted average value was $6.83. Harborlite Corp. shipped crude perlite to a company-owned plant in California.

Pumice.—Arizona was the largest producer of pumice and pumicite material in the Nation and supplied 30 percent of the total output sold or used. Principal uses of this material were for concrete admixtures and aggregate and for railroad ballast. Standard Gilsonite Co. (Pozzolan Division) supplied the Glen Canyon dam construction project with pumice for use in concrete admixtures. Scoria produced from the Superlite Builders Supply Co. Darling pit, near

Flagstaff, was used as concrete aggregate in the manufacture of building block and for other purposes. San Xavier Rock & Sand Co. continued to quarry scoria from the Douglas pit, as did Gila Cinder Co. from the Pumice No. 2 mine near Safford in Graham County. Yavapai Block Co. produced volcanic cinder from its mine in Yavapai County. Paul Zanzucchi supplied volcanic cinder from the Zanzucchi cinder pit near Flastaff to Harenberg Block Co., Inc., for use in the manufacture of concrete block. The Atchinson, Topeka and Santa Fe Railway Co., the largest producer of pumice or pumicite material in the State, produced volcanic cinder for use as railroad ballast.

Pyrites.—Ray Mines Division, Kennecott Copper Corp., recovered pyrite as a byproduct of milling copper ore at Hayden for use in the manufacture of sulfuric acid and sinter (sponge iron). The company also purchased a small quantity of pyrite produced at the Magma Copper Co. Magma mine as a supplemental feed in its sulfuric acid and sponge iron plant. Sulfur content of the pyrite produced averaged 45.1 percent.

Sand and Gravel.—Sand and gravel ranked second in terms of value of all mineral commodities produced in Arizona. Production increased from 14.5 million tons, valued at $14.2 million, in 1960 to 22 million tons, valued at $24.7 million. The main reason for the 7.5-million-ton (52-percent) increase was the requirements of sand and gravel for road building and construction of the Glen Canyon dam. Of the 22 million tons produced, 10.3 million tons was classified as commercial; 11.7 million tons was Government-and-contractor output used for highway construction. Maricopa County led in production, supplying 8.4 million tons, 38 percent of the State output. Coconino County ranked second with 5.2 million tons. A report[3] showed that from July 1956 to January 1, 1962, Arizona completed, to full or acceptable interstate standards, 224.6 miles of road, plus 289.7 miles of highway improved to standards adequate for present traffic (a total of 514.3 miles open to traffic). Work in progress with interstate funds included 43 miles under construction and 269.1 miles in engineering or right-of-way status, for a total of 312.1 miles. On the basis of mileage completed, Arizona ranked 7th in the Nation; on a construction and engineering, or right-of-way, basis it ranked 18th.

TABLE 10.—Sand and gravel production in 1961, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Apache	939	$994	Navajo	504	$547
Cochise	1,122	815	Pima	1,636	1,777
Coconino	5,161	9,427	Pinal	1,060	1,107
Gila	798	550	Yavapai	(1)	(1)
Graham	155	144	Yuma	873	684
Greenlee	(1)	(1)	Other counties	463	449
Maricopa	8,416	7,594			
Mohave	826	618	Total	21,953	24,706

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other counties."

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[3] Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1961. Press release BPR 62-4, Feb. 7, 1962.

Stone.—Stone production declined 16 percent in quantity and 9 percent in value from 1960. Reduced output of basalt, limestone, and miscellaneous stone by the Federal Bureaus of Public Roads and Indian Affairs was mainly responsible for the decrease. San Manuel Copper Corp. delivered 14,338 tons of quartzite to the company plant for metallurgical uses.

TABLE 11.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,448	$1,821	1,885	$2,556
Paving	519	488	772	637
Railroad ballast	-----	-----	8	8
Fill	131	77	253	285
Blast	-----	-----	(1)	(1)
Engine	(1)	(1)	(1)	(1)
Oil (hydrafrac)	(1)	(1)	20	204
Other	46	172	34	36
Total sand	2,144	2,558	2,972	3,726
Construction gravel:				
Building	1,548	1,951	1,669	2,129
Paving	2,086	2,049	3,408	2,659
Railroad ballast	-----	-----	(1)	(1)
Fill	392	212	1,794	596
Other	201	205	351	412
Miscellaneous gravel	-----	-----	89	177
Total gravel	4,227	4,417	7,311	5,973
Total sand and gravel	6,371	6.975	10,283	9,699
Government-and-contractor operations:				
Sand:				
Building	113	113	909	1,809
Paving	1,058	976	898	657
Fill	74	19	56	21
Total sand	1,245	1,108	1,863	2,487
Gravel:				
Building	29	38	3,394	6,776
Paving	6,833	6,108	6,407	5,738
Fill	12	6	-----	-----
Other	-----	-----	6	6
Total gravel	6,874	6,152	9,807	12,520
Total sand and gravel	8,119	7,260	11,670	15,007
All operations:				
Sand	3,389	3,066	4,835	6,213
Gravel	11,101	10,569	17,118	18,493
Grand total	14,490	14,235	21,953	24,706

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

TABLE 12.—Stone production in 1961, by counties

County	Short tons	Value	County	Short tons	Value
Apache	133,500	$133,500	Pinal	(1)	(1)
Cochise	(1)	(1)	Santa Cruz	200	$288
Coconino	374,593	409,043	Yavapai	(1)	(1)
Gila	(1)	(1)	Yuma	7,155	7,155
Greenlee	(1)	(1)	Undistributed	3,059,229	4,041,769
Maricopa	7,650	34,725			
Mohave	(1)	(1)	Total	3,582,327	4,626,480
Pima	(1)	(1)			

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

TABLE 13.—Stone sold or used by producers, by kinds

Year	Granite		Basalt and related rocks (traprock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1957	(1)	(1)	800	$800	1,700	$29,500	1,138,200	$1,504,000
1958	(1)	(1)	(1)	(1)	3,600	62,800	1,122,800	1,399,540
1959	87,968	$58,762	(1)	(1)	(1)	(1)	1,345,200	1,678,900
1960	(1)	(1)	647,441	651,845	(1)	(1)	1,782,967	2,079,263
1961	7,155	7,155	285,371	285,850	4,513	60,732	2,099,455	2,458,371

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1957	903,053	$1,410,087	56,806	$37,296	2,100,559	$2,981,683
1958	322,747	1,194,746	78,831	73,483	1,527,978	2,730,569
1959	238.101	820,146	796,416	1,440,647	2,467,685	3,998,455
1960	490,339	1,175,090	1,328,560	1,200,710	4,249,307	5,106,908
1961	334,557	942,155	851,276	872,217	3,582,327	4,626,480

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other stone."

MINERAL FUELS

Coal (Bituminous).—Lawrence Isaac Coal Co. produced a small quantity of coal (less than 1,000 tons) from the Cow Spring No. 3 mine in Coconino County.

Petroleum and Natural Gas.—Production of petroleum, from wells in Apache County, totaled 67,000 barrels, 8 percent below the 1960 output. During the year, 23 wells (15 exploratory and 8 development) were completed. Exploratory drilling resulted in one oil discovery. Two of the development wells completed were successful, one for oil and one for gas. The Kaibab National Forest was opened to oil and gas exploration. As of June 12, lease applications for 400,000 acres had been filed on this area and were awaiting action by the Federal Bureau of Land Management.

TABLE 14.—Stone sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction ... short tons	12,479	$91,607	3,926	$38,813
Rubble ... do	(1)	(1)	2,121	8,852
Architectural:				
Rough ... cubic feet	(1)	(1)	600	1,350
Approximate equivalent in short tons	(1)	------	45	------
Dressed ... cubic feet	(1)	(1)	427	1,116
Approximate equivalent in short tons	(1)	------	32	------
Flagging ... cubic feet	77,918	133,486	55,598	47,736
Approximate equivalent in short tons	5,844	------	4,170	------
Other (quantity approximate in short tons)	3,356	67,047	------	------
Total dimension stone (approximate, in short tons)	21,679	292,140	10,294	97,867
Crushed and broken stone:				
Riprap ... short tons	20,717	26,154	33,063	25,023
Metallurgical ... do	373,303	743,266	429,713	939,809
Concrete and roadstone ... do	2,292,231	2,147,404	1,421,648	1,446,994
Other ... do	[2] 1,541,377	[2] 1,897,944	[3] 1,687,609	2,116,787
Total crushed and broken stone ... do	4,227,628	4,814,768	3,572,033	4,528,613
Grand total (approximate, in short tons)	4,249,307	5,106,908	3,582,327	4,626,480

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Includes cement, lime, abrasives, roof granules, pottery, porcelain, tile, terrazzo, and agriculture.
[3] Includes cement, lime, abrasives, roof granules, pottery, porcelain, tile, terrazzo, plaster sand, stucco, andscaping, agriculture, and mineral food.

REVIEW BY COUNTIES

Apache.—The mining of uranium ores at 16 operations in the Carrizo and Lukachukai Mountains accounted for 39 percent of the State's total shipments of uranium ores. Uranium and its coproduct, vanadium, accounted for 70 percent of the county total value of mineral output. Principal producers were Kerr-McGee Oil Industries, Inc., at the Mesa group mines and VCA at the Monument No. 2 mine. The U_3O_8 content of the 89,421 tons of ore shipped during the year ranged between 0.13 percent and 0.43 percent, averaging 0.25 percent, on a weighted basis. The f.o.b. mine value of the ore ranged between $6.76 and $37.85 per ton, averaging $20.69 per ton. Vanadium, recovered from Apache County uranium ores, was processed at mills in Colorado and New Mexico which were equipped with vanadium-recovery units.

Petroleum production was 8 percent lower than in 1960. Of 23 new wells drilled in Arizona during the year, 18 were in Apache County. County drilling totaled 64,788 feet. Two development wells (one oil, one gas) and one exploratory oil well were successful.

Output of sand and gravel sold and used was more than doubled during the year, owing to increased production by the Federal Bureau of Indian Affairs and the Arizona State Highway Department, as well as the operations of Vinnell Corp. Stone production declined from 642,000 to 134,000 short tons as road construction in the county by the Bureau of Indian Affairs declined. The mining of bentonite from the Cheto mine near Sanders by Filtrol Corp. increased.

TABLE 15.—Value of mineral production is Arizona, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Apache	$5,212,471	[1] $4,986,845	Uranium ore, vanadium, sand and gravel, petroleum, clays, stone, helium, gem stones.
Cochise	44,255,697	48,857,698	Copper, gold, stone, lime, silver, sand and gravel, zinc, pumice, lead, gem stones, scrap mica, uranium ore.
Coconino	7,622,708	13,461,281	Sand and gravel, pumice, uranium ore, stone, copper, gem stones, vanadium, silver.
Gila	47,186,532	43,569,443	Copper, asbestos, sand and gravel, molybdenum, lime, stone, silver, gold, gem stones, iron ore, lead, zinc, mercury, clays.
Graham	150,596	158,979	Sand and gravel, pumice, gem stones, copper, silver.
Greenlee	70,413,650	70,016,363	Copper, lime, silver, molybdenum, sand and gravel, gold, stone, gem stones.
Maricopa	[2] 6,120,634	7,883,688	Sand and gravel, clays, manganese ore and concentrate, stone, mica (scrap), mercury, gem stones, copper, perlite, gold, silver.
Mohave	346,651	831,854	Sand and gravel, stone, feldspar, copper, gem stones, gold, zinc, silver, iron ore, lead.
Navajo	2,220,445	1,996,143	Uranium ore, sand and gravel, copper, vanadium, gem stones, silver, zinc, lead.
Pima	98,271,821	106,865,830	Copper, cement, molybdenum, sand and gravel, silver, gold, stone, zinc, clays, gem stones, lead.
Pinal	106,722,094	107,827,684	Copper, molybdenum, gold, sand and gravel, silver, gypsum, lime, pyrites, stone, perlite, clays, diatomite, gem stones, lead, zinc.
Santa Cruz	816,087	636,840	Zinc, lead, silver, copper, gold, gem stones, stone.
Yavapai	26,710,885	25,879,720	Copper, cement, zinc, lead, stone, silver, gold, lime, molybdenum, gypsum, sand and gravel, gem stones, clays, pumice, beryllium concentrate.
Yuma	584,511	705,465	Sand and gravel, gem stones, stone, gold, lead, copper, silver, zinc.
Undistributed [3]	[2] 590,255	832,608	
Total [4]	[2] 415,512,000	432,614,000	

[1] Petroleum value is preliminary.

[2] Revised figure.

[3] Includes tungsten concentrate (1960) and some stone, manganiferous ore and concentrate (1960), sand and gravel (1960), and gem stones that cannot be assigned to specific counties.

[4] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

Cochise.—The value of mineral commodities produced was substantially higher than that reported for 1960. Increased output of copper accounted for a substantial part of the gain.

Cochise County was the State's leading gold producer, ranked second in production of zinc, third in production of silver and lead, and fourth in production of copper. Copper supplied 88 percent of the value of mineral output in the county; gold, 4; silver, 2; and zinc, 1 percent, respectively. Phelps Dodge Corp., Copper Queen Branch, accounted for most of the copper and gold production, from operations at the Copper Queen underground mine and the Lavender Pit at Bisbee. According to the company annual report, production from the Copper Queen underground mine increased approximately 17 percent, from 509,700 tons in 1960 to 595,000 tons. Copper recovered from this ore totaled 25,575 tons in 1960 and 30,398 tons in 1961, a 19-percent increase. At the Lavender Pit, 18.6 million tons of material was handled, 4.9 million tons of which was ore. This was an increase of 2.8 million tons of material handled, of which 683,000 tons was ore. The ratio of waste and leach material to milling ore mined in 1961 was 2.77 to 1, compared with 2.73 to 1 in 1960. The Lavender Pit concentrator treated 5.1 million tons of ore at an average rate of 17,193 tons per operating day, of which 4.9 million tons was from the Lavender open-pit mine and 198,000 tons was from underground operations. The Douglas smelter treated 848,000 tons of copper-bearing material. Ore products treated at the smelter included those derived from the underground mines at Bisbee, concentrate from the Lavender Pit concentrator, and copper precipitates produced from leached material from the Lavender Pit.

The Johnson Camp mine, a copper-zinc property, was operated by lessees. An underground operation by McFarland & Hullinger through the Moore shaft was the county's largest producer of zinc. Strong & Harris, Inc., produced 65,116 tons of siliceous copper ore from a surface operation on the Burro claims.

Nonmetals accounted for 5 percent of the county value of mineral production. Lime was produced at Paul Lime Plant, Inc., and pumice by San Xavier Rock & Sand Co. near Douglas. Sand and gravel was produced mainly by the Arizona State Highway Department; stone was produced by commercial firms for use as an agricultural mineral, for terrazzo, for smelter flux, and for the manufacture of lime.

Coconino.—Coconino County ranked first in the value of sand and gravel production, which furnished 70 percent of the value of mineral production. Construction at Glen Canyon dam was responsible for most of the 180-percent increase in output (sold or used) that occurred during the year.

The county also ranked first in tonnage and value of pumice, accounting for 97 percent of the State production and value of this commodity. Shipments were reported by seven producers in the Winona and Flagstaff areas. The Atchison, Topeka & Santa Fe Railway Co., in the Winona area, was the State's largest producer. The Federal Bureau of Public Roads was the largest producer of stone in the county, accounting for 80 percent of the total production of 374,593 tons.

In spite of the 16-percent decrease in output, Coconino County maintained its position as the second largest producer of uranium ore, accounting for 34 percent of the State production. Uranium ore shipments from 17 operations furnished 13 percent of the total value of mineral production in the county. The major producer was Western Equities, Inc., at the Orphan mine. A number of operators in the *Cameron* district also produced uranium ore. A small quantity of copper and silver was recovered by Rare Metals Corporation of America from the Tuba City tailing dump and by Clyde Hutcheson from copper ores at the Ridenour mine near Flagstaff.

Gila.—As in 1960, copper was the principal mineral commodity produced in Gila County, in terms of value, accounting for $41.4 million, or 95 percent of the total value. Most of the copper (99 percent) came from four principal operations—Inspiration, Copper Cities, Miami, and the Castle Dome dump.

The Inspiration Consolidated Copper Co. Inspiration mine, in the *Globe-Miami* district, continued to be the leading copper producer in the county and ranked sixth in the State. According to the company annual report, the Inspiration Division was closed for two periods in 1961, other than holidays. The first period, from February 13 to 19, inclusive, was due to unfavorable market conditions that existed in the first quarter. The second period was caused by a strike called by the International Association of Machinists that lasted from September 27 through October 22. Except for these delays, mining and ore treatment proceeded normally during the year at capacity rate, 7 days per week. Operations at the smelter were varied to suit the inflow of material. According to the annual report, the 4.8 million tons of ore mined had an average content of 0.908 percent copper (0.429 percent oxide copper, 0.479 percent sulfide copper). A total of 3.4 million tons of waste was removed, of which 674,000 tons, containing values recoverable by leaching, was segregated for such treatment. Ratio of ore to waste was 0.71:1 compared with 0.77:1 in 1960. A total of 74.45 million pounds of copper was produced from Inspiration ores, or 15.83 pounds of copper per ton of ore treated. Production from leaching-in-place of mined-out areas and waste dumps accounted for 3.88 million pounds of copper, raising the total production to 78.3 million pounds. In 1961 all ore was moved to the primary crusher by truck, eliminating underground rail haulage used in previous years. Although not in use, the underground transfer and haulage system was maintained on a standby basis for possible future need. Repairs to the underground haulage drift, damaged by fire in August 1960, were completed.

The grade of concentrate was improved by revising the concentrate treatment process. The principal benefit derived from this change was a decrease of approximately 40 percent in the amount of material that had to be treated and discarded. The improved concentrate also was easier and quicker to smelt. A rotary-type, gas-fired concentrate drier was installed, aiding in the reduction of smelting costs.

Tennessee Copper Co., Miami Copper Co. Division, produced copper from the Copper Cities and Miami mines and the Castle Dome dump in the *Globe-Miami* district. The three properties were the second, third, and fourth largest producers in the county, accounting for 43 percent of the copper output.

Gold and silver were recovered as byproducts by leading copper producers. Lead and zinc also were produced in the county, all by August Kaempf from the Extension and So So mines in the *Pioneer* mining district. Molybdenum was recovered from copper ores produced at the Inspiration mine. Mercury output came from the Ord mine operated by James T. McFarland and from the Rattlesnake mine operated by Gus Packard.

Nonmetals production accounted for 4 percent of the value of mineral output. The Jaquays Mining Corp. (Regal and Chrysotile mines), Metate Asbestos Corp. (Metate group), Pan American Fiber Corp. (Rock House mine stockpile), and Phillips Asbestos Mines (Phillips mines) provided all the asbestos produced in Arizona. Sand and gravel was produced in the county by the Arizona State Highway Department, the Federal Bureau of Public Roads, and the Vinnell Corp.

Graham.—Sand and gravel produced by contractors for the Arizona State Highway Department and by one commercial operator accounted for 90 percent of the total value of mineral output in the county. Pumice produced by Gila Cinder Co. from the Pumice No. 2 mine near Safford accounted for an additional 9 percent. Copper and silver recovered from copper ores of the Coronado mine, operated by Donald Parcher in the *Stanley Butte* district, and gem stones (Apache tears, green garnet, chalcedony, chrysocolla, and agate) accounted for the remaining 1 percent.

At the Safford copper deposit Kennecott Copper Corp. completed in April the 804-foot development shaft; 3,000 feet of underground workings were driven from the shaft to and within the ore body (crosscut 1,510 feet, drifted 1,538 feet). An extensive program of underground diamond drilling was underway to delineate in detail the extent, grade, and mineralogical nature of the ore body. Bulk sampling of development ore supplied material processed in the pilot plant, recently erected on the property. The company did not expect to place the property in production in the near future.

Greenlee.—The value of copper output declined from $67.8 million in 1960 to $66.9 million. It supplied 96 percent of the value of mineral production in the county. The Morenci open-pit copper mine, operated by the Morenci Branch, Phelps Dodge Corp., maintained its position as the largest producer of copper in the State and ranked second in the Nation in 1961. In addition, the Morenci mine was the State's third largest producer of molybdenum, the second largest producer of silver, and the sixth largest gold producer; all three were recovered as byproducts from the refining of copper ore. Morenci supplied all the copper, silver, gold, and molybdenum produced in the county. According to the company annual report, 43.5 million tons of material was handled, of which 16.3 million tons was ore. This was a 22-percent increase in the tonnage of material handled, compared with 1960. The ratio of waste and leached material to ore at this property was 1.67:1, compared with 1.46:1 in 1960. The concentrator treated 16.2 million tons of ore during the year at an average rate of 53,321 tons per operating day. The smelter treated 490,634 tons of concentrates. Production of copper increased from 105,640 tons in 1960 to 111,443 tons. Large-scale tests were carried on at Morenci on two separate processes for the recovery of the small amount of oxide copper in sulfide ores treated at the concentrator. Testing of one of the processes was discontinued pending further laboratory study. A new process was installed at the Morenci smelter to facilitate the removal of oxygen from copper in the anode furnace by reformed natural gas instead of wood poles. The company operated a limekiln at the property to provide lime for metallurgical purposes.

Maricopa.—Maricopa County was the leading producer of sand and gravel, producing more than 38 percent of the State's entire output. Nonmetals accounted for 99 percent of the value of mineral production in the county, of which sand and gravel supplied 96 percent. Eleven commercial operators produced 7.7 million tons of sand and gravel, and Government contractors produced the remainder. United Materials, Inc., Vinnell Corp., Union Rock & Materials Co., and Arizona Sand & Rock Co. were the major commercial producers. Miscellaneous clay produced by Phoenix Brick Yard and Wallapai Brick & Clay Products, Inc., was used in the manufacture of brick and miscellaneous clay products. A small quantity of scrap mica was mined by Buckeye Mica Co., the State's only producer of mica.

Manganese concentrate was recovered from tailing at the Ambrosia mill by Thunderbird Metallurgical, Inc., Tolleson. Mercury was produced by Thomas E. Bolick at the National mine and by Bacon, Grimes

& Brunson at the Pine Mountain mine (Turnbull claims). Small quantities of gold, silver, and copper came from five lode mines and one placer mine.

Mohave.—Nonmetals accounted for 96 percent of the value of all minerals produced. Contractors for the State highway department produced 331,200 tons of paving sand and gravel. Government construction and maintenance crews produced an additional 10,100 tons for the Federal Bureau of Reclamation. Vinnell Corp. produced 484,200 tons of paving sand and gravel. IMC produced crushed sandstone at the Arizona Quartz quarry, and T & K Building Stone produced rough architectural sandstone at the Arizona Mist quarries. A small quantity of feldspar was produced for IMC by Jerry Haynes at the Taylor mine. Metals output (gold, silver, copper, lead, and zinc) came from copper-zinc, gold, silver, and zinc ores mined in the *Cedar Valley*, *Wallapai*, and *Cottonwood* mining districts. Iron ore was produced by George B. Smith Chemical Works, operator of the Sally mine. Duval Sulphur & Potash Co. continued fieldwork, primarily exploration drilling, at its Mineral Park copper-molybdenum property near Kingman. Toward the close of the year, a program of close-pattern drilling and underground development was initiated to provide detailed information for developing a plan for stripping and mining the deposit. The underground development would verify the drilling results and provide material for metallurgical testing. Work underway was scheduled for completion by mid-1962, at which time final development of the property for production was to be considered.

Navajo.—Uranium ore supplied $1.3 million (67 percent) of the $2 million value of mineral production. The major producer was Industrial Uranium Co., operating the Big Chief, Moonlight, East Starlight, Starlight No. 1, and Sunlight mines. Properties of A & B Mining Co., G & G Mining Co., and Inar Norgaard also were in operation during the year. A small quantity of vanadium was recovered from uranium ores produced by A & B Mining Co. Contractors for the State highway department accounted for most of the sand and gravel produced. Copper, silver, lead, and zinc output accounted for 5 percent of the mineral production value.

Pima.—Copper furnished 85 percent of the value of minerals produced. Five mines—New Cornelia, Esperanza, Silver Bell, Pima, and Mission Unit—supplied 84 percent of the copper produced in the county and 25 percent of that produced in the State.

According to the Phelps Dodge Corp. annual report to stockholders, the New Cornelia Branch produced 24 million tons of material from the New Cornelia open-pit mine near Ajo. Of the total production, 9.4 million tons was ore and 14.7 million tons was waste. The ratio of waste to ore was somewhat lower—1.57:1, compared with 1.62:1 in 1960. The Ajo concentrator processed 9.3 million tons of ore at an average rate of 31,000 tons per day, producing 240,000 tons of concentrate, from which the smelter obtained 70,334 tons of copper.

According to the company annual report, the Esperanza open-pit copper property, owned and operated by Duval Sulphur & Potash Co., operated at capacity throughout the year. Improvements in milling practice increased the yield of copper per ton of ore milled. This was the second consecutive year that increased copper recovery had been achieved. However, output of copper declined slightly, owing to a reduction in the average copper content of the ore milled. Output of molybdenum, recovered as a byproduct, increased. Plans were completed for the installation of heap-leaching and precipitation facilities to recover copper from several mine dumps. These facilities, of conventional design, were expected to be completed early in 1962. The presence of substantial additional copper-molybdenum reserves in an area due west of the existing pit was disclosed by development drilling. The new reserves exceeded the tonnage of ore mined through 1961 at Esperanza. Mineralization in the new area was typical of that of the principal Esperanza ore body.

The average price received for copper contained in concentrates was 30.3 cents per pound before applicable smelting, refining, and transportation costs, compared with 32.8 cents per pound in 1960.

Silver Bell Unit of Asarco was operated normally throughout the year. The company increased smelting capacity at Hayden to handle concentrate from Mission Unit.

According to the Cyprus Mines Corp. annual report, Pima Mining Co. (50 percent owned by Cyprus Mines Corp.) mined and milled 1.4 million tons of ore averaging 1.38 percent copper, compared with 1.3 million tons in 1960. Mill output totaled 63,613 tons of copper concentrate, up 27 percent from the 1960 production of 50,044 tons. An improvement in the grade of ore and increased concentrate production were expected in 1962.

The Banner Mining Co. Palo Verde shaft was completed to a depth of 1,028 feet in November, approximately 1 year behind schedule according to the company annual report. The delay in reaching the planned depth of 1,020 feet was caused by the large flow of water encountered at the 960-foot level and the time required to drain the area and reduce the volume of water to be handled. Also delayed was the opening for mining of deeper levels in the Palo Verde shaft. Meanwhile, development headings totaling 3,541 feet of drifting and 2,872 feet of raises, were driven on the 700- and 800-foot levels. In addition, 7,912 feet of diamond drilling, 3,870 feet of rotary drilling, and 9,606 feet of long-hole drilling, together with 73 feet of shaft sinking, were accomplished. After completion of the shaft to the 1,028-foot level, work was started on stations and pockets on the 900-foot level in preparation for development and mining on this level. The Mineral Hill mill was enlarged to handle increased tonnage of ore from the mine. Output of crude ore from this property totaled 158,546 tons, from which 3,492 tons of copper, 102,106 ounces of silver, and 80.53 ounces of gold were recovered in concentrates. Underground operations at the Daisy mine were discontinued on January 20, owing to the proximity of open-pit mining by Pima Mining Co. on Banner ground. Stripping of overburden and rock on Banner ground, under the operating agreement made in 1959 with Pima Mining Co., proceeded at a satisfactory rate during the year, and 61,315 tons of low-grade oxidized ores was stockpiled. Production from the Daisy mine totaled 245 tons; exploration and development consisted of 56 feet of crosscutting and drifting.

The Atlas mine, operated by B.S. & K. Mining Co., was the main producer of zinc. Silver was recovered mainly as a byproduct of copper refining. The major silver producers in the county, in order of production, were New Cornelia (Phelps Dodge Corp.), Mission Unit (Asarco), Pima (Pima Mining Co.), Esperanza (Duval Sulphur & Potash Co.), and Silver Bell Unit (Asarco).

The largest producer of gold was Phelps Dodge Corp. from the New Cornelia mine, *Ajo* mining district.

Molybdenum was produced by Duval Sulphur & Potash Co. from the Esperanza pit and by Asarco from Silver Bell Unit.

Cement was the principal nonmetal product. California Portland Cement Co., Arizona Portland Cement Co. Division, at Rillito, was active throughout the year. The tonnage and value of shipments were 6 percent lower than in 1960.

Of the 1.6 million tons of paving sand and gravel produced, contractors for the Arizona State Highway Department, the Pima County Highway Department, and the Federal Bureau of Public Roads produced 756,600 tons. Government construction and maintenance crews furnished an additional 77,800 tons of sand and gravel. Five commercial operators produced 801,000 tons, of which 93 percent was supplied M. M. Sundt Construction Co., Tucson Rock & Sand Co., and Wilmot Sand & Gravel, Inc. Limestone for cement manufacture was the principal stone produced. Most of the output was quarried and consumed by Arizona Portland Cement Co.; a small quantity was used as a roofing material. A small tonnage of marble was quarried for landscaping and for roofing granules. Charles H. Anderson produced crushed standstone at the Little Chief quarry for use as a smelter flux. Manufacturers of building brick and other structural clay products furnished the entire miscellaneous clay output. The leading producers in order of output were Grabe Brick Co., Tucson Pressed Brick Co., and Devry Brick Co., Inc.

Pinal.—Pinal County led in the production of copper, producing almost 29 percent of the State output. Copper accounted for $100 million (93 percent) of the $108 million value of mineral output. Three mines, San Manuel (second largest producer in the State), Ray pit (fifth), and Magma (ninth), supplied 99 percent of the county and 28 percent of the State output.

According to the annual report of Magma Copper Co., production at the Magma mine at Superior was 410,958 tons of ore assaying 5.16 percent copper, 0.036 ounce of gold, and 1.58 ounces of silver. Comparable production in 1960 was 386,636 tons assaying 5.10 percent copper, 0.04 ounce of gold, and 1.73 ounces of silver. In addition, 6,409 tons of custom ore was treated, compared with 440 tons in 1960. Smoke from a fire that broke out on December 2 in a section of the east replacement workings that had been mined out several years before and allowed to cave, interrupted mine production. The area had not been sealed off by yearend. The fire, presumably caused by spontaneous combustion of splintered and crushed mine timber, was confined to timber in the affected area. During November, the last full month of operation before the fire, 91 percent of all production came from the east replacement area. Production from the main vein west of the No. 5 shaft was discontinued, owing to high extraction and maintenance costs. The company estimated that stoping on the main vein in the central area would cease in 1962 unless development disclosed further ore amenable to economic extraction. Metal production from ore milled at Magma included 20,761 tons of copper, 14,641 ounces of gold, and 613,442 ounces of silver. Development footage completed at Magma totaled 28,220 feet—13,780 feet of crosscuts, 5,177 feet of raises, and 9,263 feet of diamond drilling. Vein ore reserves in the western part of the mine had decreased in the last few years, but additions to the bedded ore reserves in the east replacement zone were about equal to the bedded ore mined.

San Manuel Copper Corp., wholly owned by Magma Copper Co., was the largest producer of copper in the county and second largest in the State. According to the annual report of the parent company, the San Manuel mine produced 12,529,243 tons of ore assaying 0.727 percent sulfide copper, compared with 12,261,220 tons assaying 0.710 sulfide copper in 1960. The tonnage of ore mined per operating day averaged 35,063 against 34,249 in 1960. Copper recovery per ton of ore mined was 13.19 pounds, compared with 12.93 pounds in 1960. Metal production was 82,612 tons of copper, 3,869,166 pounds of molybdenum sulfide, 17,597 ounces of gold, and 295,553 ounces of silver. The mill treated 12,448,549 tons of ore at an annual rate of 34,837 tons per operating day. Approximately 85 percent of the total copper and 91 percent of the sulfide copper contained in the ore was recovered. The smelter processed 301,781 tons of copper concentrates for an average of 848 tons per day for the year. Preparation of the second level of the San Manuel mine for production was nearing completion with some production scheduled to commence in April 1962. The company began production from its State leases in the summer of 1961. The San Manuel mine quarry yielded 53,181 tons of limestone and 14,338 tons of quartzite for metallurgical uses.

In its annual report, Kennecott Copper Corp. stated that its Ray Mines Division had established new records for tonnages of ore and waste handled and for copper produced, despite a serious shortage of water in the summer months after 2 abnormally dry years. The company mined 7.4 million tons of ore compared with 6.5 million tons in 1960. Copper production from all sources at Ray (mining and milling of ore and the leaching of waste dumps and ore in place) was 64,170 short tons, compared with 58,799 tons in 1960.

All of the molybdenum was recovered from ores produced by San Manuel Copper Corp. and D.M.B.D. Mining Co. Gold and silver also were produced as byproducts of copper. Major producers of gold, listed in order of production, were San Manuel, Magma, and the Ray pit. Silver was produced at the same properties but in different order; Magma was the leading producer, followed by San Manuel and Ray pit. Combined production of silver from Magma and San Manuel declined from 914,758 ounces in 1960 to 908,995 ounces, despite an increase in output at San Manuel. The decline in output was attributed to a lower silver content, inasmuch as the tonnage of ore from both mines increased.

Nonmetals accounted for 2 percent of the total value of mineral production. Lime was produced by San Manuel Copper Corp. for use at the San Manuel concentrator. Diatomite was mined by American

Diatom, Inc., at the White Cliffs mine for use as a filler, and by Phoenix Gems, Inc., for use as a filler in insecticides. Perlite produced by Arizona Perlite Roofs, Inc., and the Harborlite Corp. was expanded at Tucson and California expanding plants for use in building plasters and other construction applications. Gypsum was produced by Arizona Gypsum Co. and National Gypsum Co. near Winkelman. Miscellaneous clay mined by the Phoenix Brick Yard from clay at the Pantano mine was used in the manufacture of building brick and other clay products.

Santa Cruz.—Output of zinc, lead, copper, silver, and gold accounted for all but an insignificant portion of the county value of mineral production. With the exception of gold, output of the metals was lower than in 1960. Nash & McFarland, the State's second largest lead producer, operated the Flux mine in the *Harshaw* district. The Flux mine ranked fifth in the State in the production of zinc.

Yavapai.—The value of mineral production was 3 percent lower than in 1960, mainly because of a 10-percent decline in the value of copper and a 27-percent decline in the value of zinc. The decline would have been greater, except that cement output increased 87 percent in value. Gold, silver, copper, lead, and zinc furnished 65 percent of the total value of mineral output. Yavapai County led the State in output of lead and zinc.

The Iron King mine, Shattuck Denn Mining Corp., was the largest producer of lead and zinc in the State and supplied most of the county output. According to its annual report, Shattack Denn mined and milled 235,010 tons of ore and produced 44,027 tons of concentrates yielding 14,549 ounces of gold, 550,913 ounces of silver, 8 million pounds of lead, 28.4 million pounds of zinc, and 344,000 pounds of copper. The company continued exploration and development on the indicated southern extension of the mineralized structure near and parallel to the main ore vein system of the Iron King mine.

According to the annual report of Bagdad Copper Corp., production by the company was 20,933,747 pounds of sulfide copper and 1,005,616 pounds of leached oxide copper, compared with 23,862,459 pounds of sulfide copper in 1960. No leached copper was produced in 1960. The average price for copper was 30.06 cents per pound, compared with 32.3 cents per pound in 1960. Stripping proceeded at a somewhat faster pace than mining. The average grade of sulfide ore was 0.71 percent, compared with 0.85 percent in 1960. This accounted for most of the difference in production between the 2 years, as the amount of ore milled decreased only slightly from that of 1960. By mixing high- and low-grade ores, the company expected an average milling grade in 1962 of about 0.80 percent. Plant capacity was to be increased about 20 percent when the sixth ball mill goes into production in April 1962. The increased capacity, together with improvements in the grade of milling ore, should yield in excess of 24 million pounds of copper in 1962. Enough high-grade ore was in sight to last until a better grade of ore could be reached in the main ore body.

The annual report of Cyprus Mines Corp. showed mine and mill production of 95,386 tons from its Old Dick and Copper Queen mines near Bagdad, compared with 80,940 tons in 1960. The increase in production came from a new heavy-medium separation plant. Production of copper concentrate increased to 12,884 tons from 11,028 tons in 1960. Output of zinc increased 1,630 tons, to 14,291 tons. Reported unit operating costs were lower. On December 31, proven ore reserves were estimated at 319,000 tons averaging 3.3 percent copper and 10.7 percent zinc. The Old Dick shaft was deepened to 950 feet, and exploration was continued in an effort to extend the life of these ore bodies.

Beryl was produced by Earl F. Anderson at the Homestead lode and by V. R. Denning at the Outpost mine.

Cement, the principal nonmetal commodity produced in the county, increased 87 percent in value. Output rose mainly because of increased requirements for cement at the Glen Canyon dam. Output of stone increased slightly, most of the production being limestone used for the production of cement. The Flintkote Co., United States Lime Products Division, produced quicklime for use mainly by the chemical industry, and hydrated lime used in construction. Arizona Gypsum Co. mined gypsum from the Camp Verde deposit for use as a portland cement retarder and for agricultural use. Yavapai Block Co. mined scoria from its Cruice cinder pit near Ashfork. Miscellaneous clay was produced by American Cement Corp., Phoenix Cement Co. Division, for use in portland cement.

Yuma.—Sand and gravel was the principal mineral commodity produced, accounting for 97 percent of the total value of mineral output. Contractors for the Arizona State Highway Department and the Federal Bureau of Reclamation, and construction and maintenance crews for the Yuma County Highway Department, produced 822,000 tons of paving and structural sand and gravel.

Small quantities of copper, silver, gold, lead, and zinc were recovered from seven small lode and two placer operations. All the lead and zinc and most of the gold and silver were produced at the New Chance mine operated by Lyman Wall. Most of the copper was produced at the Magic mine by B. L. Gary.

The Mineral Industry of Arkansas

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological and Conservation Commission, Norman F. Williams, Director and State Geologist, Little Rock, Ark.

By Raymond B. Stroud[1]

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ARKANSAS mineral output was valued at $149.1 million in 1961. Although this value was the second highest recorded, it was 6 percent less than the record valuation of $158.3 million set in 1960. This marked the second time in the decade, 1952–61, that the value of mineral output failed to exceed that of the preceding year. Most of the loss in mineral value was attributed to decreased bauxite output, but substantial declines also were registered in the production value of clays, coal, gem stones, natural gas liquids, petroleum, sand and gravel, soapstone, stone, and zinc.

Production of 17 minerals and mineral products contributed significantly to the State economy. Gains were recorded in quantity and value of six of the mineral products mined.

TABLE 1.—Mineral production in Arkansas[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite ..... short tons	277,851	$2,578	277,855	$2,630
Bauxite ..... long tons, dried equivalent	1,932,071	20,469	1,178,898	13,462
Clays ..... thousand short tons	815	2,456	773	1,758
Coal ..... do	409	3,116	395	2,888
Gem stones	(2)	38	(2)	19
Gypsum ..... thousand short tons	67	208	167	531
Lime ..... do	(3)	(3)	192	3,168
Natural gas ..... million cubic feet	55,451	6,599	59,547	8,039
Natural gas liquids:				
Natural gasoline and cycle products ..... thousand gallons	34,558	2,148	27,889	1,640
LP gases ..... do	73,252	3,735	75,157	3,286
Petroleum (crude) ..... thousand 42-gallon barrels	30,117	83,424	[4] 29,249	[4] 80,435
Sand and gravel ..... thousand short tons	8,192	10,262	9,389	9,074
Stone ..... do	10,939	13,555	12,029	12,402
Zinc (recoverable content of ores, etc.) ..... short tons	50	13	37	9
Value of items that cannot be disclosed:				
Abrasive stones, bromine, cement, lime (1960), and soapstone	----------	10,918	----------	10,906
Total Arkansas[5]	----------	[6] 158,263	----------	149,138

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Figure withheld to avoid disclosing individual company confidential data.
[4] Preliminary figure.
[5] Total adjusted to eliminate duplicating value of clays and stone.
[6] Revised figure.

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Significant gains were made in production and value of bromine, gypsum, and natural gas. Establishment of a second bromine recovery plant accounted for the gain in bromine output. Increased gypsum production was attributed to a larger output of cement. Increased consumption of natural gas accounted for a rise in output. Sand and gravel production increased; however, its total value declined. The average unit value of sand and gravel in 1961 was $0.97 per ton, a decrease of $0.28 per ton compared with 1960. Stone production increased in quantity, but the average unit value per ton was 17 percent less. Augmented output of sand and gravel and stone and increased Arkansas cement production were largely attributable to important State and Federal highway construction and several Federal dam and missile-base projects. These construction projects contributed greatly to the economy of the mineral industry and the State.

Overall economic development of Arkansas improved, and a significant increment of the economic increase was attributable, directly and indirectly, to the mineral industry. Personal income in Arkansas was estimated at $2.5 billion, an increase of more than 5 percent. Income resulting from the mining industry accounted for about 10 percent of the total. Expansion of manufacturing industries which consumed more of the State's mineral output tended to stabilize the State economy and provided a better balance with agriculture.

Nearly $45 million was pledged or invested for 63 new industrial plants and 84 major plant expansions. Transportation and communication companies spent an additional $48 million. Eighteen of the new plants utilized metallic or nonmetallic minerals in varying forms.

Construction continued on three major multipurpose dams; Greers Ferry, Dardanelle, and Beaver, and access roads were being built near a fourth, the Millwood Dam, 8 miles west of Ashdown in Little River County.

At yearend, construction was 70-percent complete at Greers Ferry Dam, on Little Red River near Heber Springs. The overall project, including construction of the powerhouse, installation of operating machinery and equipment for the dam and powerhouse, erection of a switchyard, road relocations, and public facilities, was scheduled for completion in 1964 at an estimated cost of $56 million. Two power units for hydroelectric power, with a total capacity of 96,000 kilowatts, will be installed. The Greers Ferry project will require 900,000 cubic yards of concrete and 3 million cubic yards of earth and stone.

Dardanelle Lock and Dam, at Dardanelle on the Arkansas River, was 50-percent complete at yearend. The project will provide navigation facilities for part of the Arkansas River. The navigation lock will be 110 feet wide and will accommodate tows 600 feet long. Four generating units will be installed; rated capacity will be 124,000 kilowatts, or 171,000 horsepower. Construction of the lock and dam will require 600,000 cubic yards of concrete and 218,000 cubic yards of earth and rock.

Construction of Beaver Dam, west of Eureka Springs, in Carroll County, on the White River, was about 2-percent complete at yearend. This project was scheduled for completion in June 1966 at an estimated cost of $51 million. Total capacity of two power units will be 112,000 kilowatts. In addition to hydroelectric power, the project will provide water for municipal and industrial uses and flood control.

Construction of access roads and related land-acquisition procedures for Millwood Dam were underway. The project will provide flood-control facilities, municipal and industrial water, and recreational areas. Total cost of the project was estimated at $55 million; $11 million of this figure will be used to relocate railroads and $7 million will be used to relocate highways. Total length of the earthfill dam will be about 3¼ miles; preliminary estimate of earth and rock requirements was 4 million cubic yards. Tentative time for completion of the overall project was 4 to 6 years.

Other river-basin work included levee-construction and bank-stabilization on the Arkansas and other rivers, continuation of studies and planning of the De Gray Dam on the Caddo River near Arkadelphia, and drainage and navigation improvements on the White River.

Acme Brick Co. placed in operation new facilities at its brick plant in Malvern. The new plant addition, costing $500,000, included a kiln 276 feet long with a 4-day firing cycle. Plant capacity was increased to more than 20 million brick annually, and the plant was designed so that capacity could be easily enlarged.

Arkansas' second bromine recovery plant was completed, and production of elemental bromine began in June. Arkansas Chemicals, Inc., erected the plant near El Dorado at an estimated cost of $3 million.

Construction of additional plant equipment and facilities, including a new cement kiln 450 feet long and 12 feet in diameter, doubled the capacity of the Arkansas Cement Co. plant near Foreman. The expansion cost an estimated $7 million and was virtually completed at yearend.

U.S. Barite Co. completed a new plant to recover barite and sand and gravel near Dierks. Production began in September, but technical difficulties resulted in the closing of the plant in December.

Arkansas Power and Light Co. announced plans in September to construct 667 miles of powerline at an estimated cost of $28.5 million. Completion was scheduled for 1970. The company began operating its new 348,000-kilowatt steam-electric generating station at Helena; the power station contained the largest single-shaft generator of its kind ever constructed. The plant supplied electric power to Arkansas, Mississippi, and Louisiana. Transmission-line construction projects included a 90-mile, 230,000-volt line from Helena to Pine Bluff and a 17-mile, 115,000-volt, shielded line from Stuttgart to DeWitt.

Eighteen electric cooperatives provided service in 74 of the 75 Arkansas counties; they distributed power over 39,639 miles of line and added about 400 miles of new line. Plans for 1962 included construction of an additional 345 miles of new lines. The cooperatives marketed electric power to several mineral-producing companies.

Construction began on the $10.5-million Thomas B. Fitzhugh steam generating plant on the Arkansas River near Ozark. Production of electric power at the 50,000-kilowatt plant was scheduled to begin in June 1963. The contract for manufacture of the steam-turbine generating unit for the plant had been awarded in late 1960.

Employment and Injuries.—Average annual employment dropped less than 1 percent. Employment gains made in metal and nonmetallic mining categories were offset by employment losses in petroleum, natural gas, and coal mining industries. The mining-industry payroll amounted to more than $25.9 million; it was about 1 percent higher than the 1960 annual payroll.

Average weekly wages were: Metal industry, $113.15, a 2-percent decrease; coal industry, $99.60, a 7-percent gain; crude petroleum, and natural gas industry, $93.75, a 2-percent increase; and nonmetallic mining and quarrying industries, $79.46, a 4-percent increase.

Available data indicated that two fatalities occurred in mining in 1961—one each in metallic and nonmetallic mining. No fatal accidents occurred in coal mines, but 13 nonfatal accidents were reported. Injury data pertinent to the petroleum industry were not available.

TABLE 2.—Average annual employment for selected minerals

Industry	1960		1961	
	Employing units	Employment	Employing units	Employment
Metal mining	25	619	24	647
Bituminous coal mining	22	285	21	248
Crude petroleum and natural gas	377	3,065	386	2,987
Nonmetallic mining and quarrying	105	1,484	106	1,523
Total	529	5,453	537	5,405

Source: Arkansas Department of Labor, Employment Security Division, Little Rock, Ark.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Mineral fuels contributed the largest share of the value of the State's mineral output; however, the aggregate value ($96.3 million) represented a 3-percent decline. A significant increase in natural gas output was offset by declines in production of coal, natural gas liquids, and petroleum.

Coal (Bituminous).—Output of coal decreased 3 percent in quantity and 7 percent in value compared with 1960. Twenty-one bituminous coal mines with outputs greater than 1,000 tons annually were operated. Of these, 11 were underground and 10 were strip mines; there were 10 of each in 1960. Forty-two percent of the production came from underground mines, and open-pit mines accounted for 58 percent

TABLE 3.—Coal production

(Thousand short tons and thousand dollars)

Year	Short tons	Value	Year	Short tons	Value
1952–56 (average)	659	$5,098	1959	441	$3,482
1957	508	3,976	1960	409	3,116
1958	364	2,744	1961	395	2,888

of the output. Production from underground mines increased 46 percent, and output from strip mines declined 22 percent compared with 1960. The continued decline in coal output was caused by increased competition from other fuels and a general lessening of demand.

Oil and Gas Exploration and Development.—Drilling activity in 78 fields in 23 counties resulted in 203 oil wells, 42 gas wells, and 248 dry holes. Total number of holes drilled decreased 15 percent. There were significant decreases in the number of development and exploratory wells drilled in Columbia, Lafayette, Miller, Nevada, and Union Counties; the number of wells drilled in Crawford, Franklin, and Sebastian Counties increased.

Only 50 percent of the wells drilled resulted in oil and gas production, compared with 56 percent in 1960. Eighteen new sources of oil and gas were discovered by exploratory drilling in 1961; 6 new fields (4 oil and 2 gas) and 12 new pools (2 oil and 10 gas) were located. Lateral extensions were established in 10 fields by outpost wells; 10 new pools were discovered by field-development wells. The 18 discoveries represented a success ratio of 18 percent.

The deepest well drilled in 1961 was in Lafayette County; it was abandoned as a dry hole at a depth of 11,552 feet. The deepest producing well was in the same county, from a depth of about 11,015 feet.

TABLE 4.—Oil and gas well drilling in 1961, by counties

County	Drilling						Total
	Proved field wells			Exploratory wells			
	Oil	Gas	Dry	Oil	Gas	Dry	
Arkansas						4	4
Ashley						2	2
Bradley	1						1
Calhoun	12		8			6	26
Chicot						1	1
Columbia	3		2			10	15
Crawford		8	2			1	11
Desha						1	1
Franklin		18	2		1	1	22
Johnson		2	5			2	9
Lafayette	35		30	1		17	83
Logan		2	2				4
Lonoke						1	1
Miller	31		25	1		10	67
Nevada			4			1	5
Ouachita	12		13			4	29
Pope		2	1		1	6	10
Sebastian		8	2				10
St. Francis						1	1
Union	103		51	4		27	185
Van Buren						2	2
White						2	2
Yell						2	2
Total: 1961	197	40	147	6	2	101	493
1960	280	34	129	5	5	128	581

Source: Arkansas Oil and Gas Statistical Bulletin, v. 20, No. 12, December 1960 through v. 22, No. 3, March 1962.

In northern Arkansas, dry natural gas was produced from relatively shallow sands of Pennsylvanian, Mississippian, and Devonian ages. Drilling activity in this area resulted in the discovery of 2 new gasfields and 12 new gas-supply sources. There were 52 gasfields in northern Arkansas at yearend; 8 had not been connected to a pipeline outlet.

In southern Arkansas, oil and gas production came from Cretaceous and Jurassic formations. Exploratory and development drilling, conducted in 12 counties and 58 fields, totaled 417 wells. Fourteen new sources of supply were discovered (4 fields and 10 pools). Lateral extensions of eight fields were established by successful outpost wells. At yearend, 145 of 177 fields found to date were active producers of oil, condensate, or gas.

Three new waterflood projects were begun in 1961 in southern Arkansas fields and several other pressure-maintenance and secondary-recovery projects were continued. The projects prolonged the life of fields in Columbia, Lafayette, Miller, Ouachita, and Union Counties.

Pipeline Construction.—Arkansas-Louisiana Gas Co. began operating its new 125-mile gas-transmission line from Perla Station, near Malvern, to Helena. The line was connected to a previously completed 95-mile line from northwest Arkansas to the Malvern-Hot Springs area. Larger and more sustained supplies of gas were made available by operation of the pipelines.

Natural Gas.—Production of natural gas increased for the 5th consecutive year. Output and value increased 7 and 22 percent, respectively. Northern Arkansas gasfields, in nine counties, accounted for 69 percent of the production value. Six counties in southern Arkansas recorded a production value of about $2.5 million, a 41-percent gain compared with 1960. Franklin County, in northern Arkansas, led the State; next came Lafayette, Columbia, Pope, and Sebastian Counties. Lafayette County led southern Arkansas in production.

Natural Gas Liquids.—A decline in production of natural gas liquids was recorded. Quantity and value of these commodities were 4 and 16 percent, respectively, under 1960 production. Four natural gasoline plants and one cycling plant operated throughout the year. A second cycling plant, operated by Monsanto Chemical Co., Hydrocarbons Division, at El Dorado, discontinued production on March 1.

TABLE 5.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves Dec. 31, 1960	Changes in proved reserves, due to extensions and new discoveries in 1961	Proved reserves, Dec. 31 1961 (production was deducted)	Change from 1960, percent
Crude oil................thousand barrels..	301,997	6,980	280,689	−7
Natural gas liquids [1]................do....	27,497	−2,765	22,233	−19
Natural gas.............million cubic feet..	1,459,710	81,390	1,476,992	+1

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, and American Petroleum Institute, Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. V. 16, Dec. 31, 1961, pp. 11, 12, 21.

TABLE 6.—Gross withdrawals and disposition of natural gas, in million cubic feet

Year	Gross withdrawals[1]			Disposition			
				Marketed production[2]			
	From gas wells	From oil wells	Total	Quantity	Value (thousands)	Repressuring	Vented and wasted[3]
1952–56 (average)	29,900	29,440	59,340	35,918	$1,877	18,712	4,710
1957	18,000	36,000	54,000	31,327	2,256	16,045	6,628
1958	23,000	45,000	68,000	32,890	2,664	28,180	6,930
1959	32,000	40,800	72,800	40,674	3,539	27,488	4,638
1960	45,700	41,100	86,800	55,451	6,599	27,640	3,709
1961[4]	45,800	42,100	87,900	59,547	8,039	25,748	2,605

[1] Marketed production plus quantities used in repressuring, vented, and wasted.
[2] Comprises gas sold or consumed by producers, including losses in transmission, quantities added to storage, and increases in gas in pipelines.
[3] Includes direct waste on producing properties and residue blown to air.
[4] Preliminary figures.

TABLE 7.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	51,999	$3,543	55,205	$2,325	107,204	$5,868
1957	39,869	2,313	54,034	2,097	93,903	4,410
1958	37,197	2,574	53,518	2,743	90,715	5,317
1959	40,730	2,523	55,731	3,048	96,461	5,571
1960	34,558	2,148	73,252	3,735	107,810	5,883
1961	27,889	1,640	75,157	3,286	103,046	4,926

Petroleum.—Although crude petroleum, in terms of production, continued as the State's most important mineral commodity, output and value declined; decreases of 3 and 4 percent, respectively, were recorded. Magnolia field, in Columbia County, was the State's leading oilfield, producing about 5.5 million barrels. Columbia, Union, Lafayette, and Ouachita were the leading oil-producing counties.

NONMETALS

Output of nonmetallic minerals accounted for 27 percent of the aggregate value of Arkansas' mineral production in 1961. Sales, mine shipments, or marketable production were recorded for stone, cement, sand and gravel, lime, barite, clays, bromine, gypsum, soapstone, abrasive stone, and gem stones.

Abrasive Stone.—Novaculite was quarried in Garland County for use as oilstones and whetstones. The quantity of abrasive stone produced increased 26 percent, but the value declined 6 percent.

TABLE 8.—Crude petroleum production, by fields

(Thousand barrels and thousand dollars)

Field	1960		1961 [1]	
	Barrels	Value	Barrels	Value
Atlanta	290	$803		
Buckner	309	856		
Dorcheat-Macedonia	617	1,709	603	$1,658
El Dorado	456	1,263	597	1,642
Fouke	1,088	3,014	1,074	2,954
Magnolia	5,032	13,938	5,493	15,106
McKamie	950	2,632	1,387	3,814
Midway	2,211	6,124	2,208	6,072
Schuler	1,510	4,183	1,725	4,744
Smackover	4,057	11,238	3,267	8,984
Stephens	1,182	3,274	1,108	3,047
Village	626	1,734	529	1,455
Wesson	1,717	4,756	1,539	4,232
Other fields [2]	10,072	27,900	9,719	26,727
Total	30,117	83,424	29,249	80,435

[1] Preliminary figures.
[2] Includes oil consumed on leases and net change in stocks held on leases for the State.

TABLE 9.—Crude petroleum production, indicated demand, and stocks in 1961, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks originating in Arkansas
January	2,539	2,471	1,854
February	2,428	2,484	1,798
March	2,634	2,495	1,937
April	2,500	2,161	2,276
May	2,439	2,367	2,348
June	2,329	2,577	2,100
July	2,394	2,425	2,069
August	2,405	2,541	1,933
September	2,335	2,485	1,783
October	2,398	2,396	1,785
November	2,407	2,301	1,891
December	2,441	2,574	1,758
Total	29,249	29,277	

Barite.—The quantity of barite produced was virtually the same as in 1960, but the value of the product was 2 percent more. U.S. Barite Co. (formerly U.S. Glass and Chemical Corp.) completed a barite-recovery plant at Dierks. Production of barite and gravel began in September, but the operation was discontinued in December. Virtually all of the barite was processed for use in drilling muds. Arkansas ranked first in production of barite, producing 35 percent of the Nation's output. The relatively static condition of oil drilling in the United States apparently accounted for the stabilized production of barite.

TABLE 10.—Primary barite sold or used by producers

Year	Short tons	Value (thousands)
1952–56 (average)	425,829	$3,882
1957	477,327	4,537
1958	182,779	1,668
1959	338,539	$3,097
1960	277,851	2,578
1961	277,855	2,630

Bromine.—Michigan Chemical Corp. recovered bromine from oil-well brine pumped to its El Dorado plant. Output of the plant, with a 10-million-pound annual capacity, consisted of elemental bromine and ethylene dibromide.

Arkansas Chemicals, Inc., completed construction of the State's second bromine-recovery plant in June. By yearend, the company had produced a significant quantity of bromine. Annual production capacity of the new plant was 30 million pounds of elemental bromine recovered from oil-well brine pumped from nearby fields. After removal of bromine, the brine was injected into disposal wells. Twenty men were employed in the plant.

Cement.—Combined output of portland and masonry cements at plants in Howard and Little River Counties reached a record high in quantity and value. Continued increases in State and Federal construction projects and residential building accounted for the gains. At yearend, Arkansas Cement Co. had virtually completed expansion of plant facilities to double its plant's annual capacity to 2.8 million barrels.

TABLE 11.—Shipments of portland cement to Arkansas consumers

Year	Arkansas (thousand barrels)	Change, percent	
		In Arkansas	In United States
1952–56 (average)	1,995		
1957	1,694	−8	−6
1958	2,129	+26	+6
1959	2,624	+23	+9
1960	2,590	−1	−7
1961	2,968	+15	+3

Clays.—Twenty-five clay producers had an aggregate output, from 18 counties, of 772,287 short tons of clay. Production was 5 percent less than in 1960. Large quantities of fire clay were used in making refractories, high-quality face brick, and heavy clay products. Miscellaneous clay was used to manufacture building brick, sewer pipe, and other heavy clay products. A significant quantity of clay was used in making cement.

TABLE 12.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Miscellaneous clays [1]		Fire clay		Total clay	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	255	$335	376	$1,628	631	$1,963
1957	226	226	390	1,360	616	1,586
1958	265	264	313	1,313	578	1,577
1959	383	383	399	2,023	782	2,406
1960	388	387	427	2,069	815	2,456
1961	434	428	339	1,330	773	1,758

[1] Includes clay used for cement.

Gem Stones.—Value of gem stones and mineral specimens declined 50 percent. Quartz crystals produced in Garland and Montgomery Counties comprised most of the total value reported. Other minerals produced and contributing to the value included wavellite, sphalerite, and diamond.

Gypsum.—Dulin Bauxite Co., Arkansas' only producer of gypsum, expanded and rebuilt plant facilities at Highland. A record output of 166,698 short tons of gypsum was attained, a 150-percent increase over 1960. The gypsum was used as a retarder in portland cement.

Lime.—Lime production increased significantly in quantity and value over 1960. Most of the increase resulted from inclusion of lime produced and used by papermills; this industry was not previously canvassed. Six producers in five counties reported lime output. The chemical, aluminum, petroleum, sugar-refining, and other industries were the major consumers; lesser quantities were utilized for agricultural and building purposes.

Sand and Gravel.—Production of sand and gravel gained 15 percent in quantity but declined 12 percent in value from 1960. Fifty of the 75 counties reported production. The quantity of sand and gravel used for commercial purposes decreased slightly, but the value increased. Tonnage of sand and gravel used in State and Federal construction projects increased 53 percent, but value decreased 62 percent. The decreased value apparently was due to increased competition among producers.

Soapstone.—Output and value of soapstone decreased 3 percent. The mined rock was ground and used in insecticides, roofing, and in the rubber industry.

Stone.—A record quantity of stone was produced, but the value dropped 8 percent under the record set in 1960. Types of stone produced included sandstone, limestone, marble, slate, and syenite. Crushed sandstone was used for riprap, concrete aggregate, and railroad ballast. Uses of crushed limestone, in order of importance, were roadstone, concrete aggregate, cement manufacture, flux, agricultural limestone, lime manufacture, riprap, and asphalt and fertilizer fillers. The quantity of limestone used as a soil conditioner was about one-quarter of the estimated quantity reportedly needed by Arkansas farmers; this indicated an additional potential market for agricultural limestone. Dimension sandstone and marble (sawed and dressed) were used in home construction and public buildings. Slate was used in manufacturing roofing granules and as asphalt filler. Most of the syenite produced was used in making roofing granules; the remainder was used for railroad ballast, riprap, and concrete aggregate. Increased competition among contractors engaged in State and Federal contract construction resulted in a decrease in the value of stone produced for construction purposes.

Sulfur (Recovered Elemental).—Three recovery plants were operating at yearend, compared with four plants in 1960. Byproduct sulfur was extracted at gas-cycle plants in Columbia, Lafayette, and

TABLE 13.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,348	$1,324	1,350	$1,459
Paving	1,001	903	959	906
Fill	246	130	(1)	(1)
Other [2]	282	752	570	1,104
Total sand	2,877	3,109	2,879	3,469
Gravel:				
Building	1,503	1,889	1,214	1,728
Paving	1,376	1,652	1,717	1,604
Fill	152	61	57	28
Other [3]	27	21	66	63
Total gravel	3,058	3,623	3,054	3,423
Total sand and gravel	5,935	6,732	5,933	6,892
Government-and-contractor operations:				
Sand: Paving	699	1,071	1,978	787
Gravel:				
Paving	1,558	2,459	1,407	1,363
Fill	----------	----------	71	32
Total gravel	1,558	2,459	1,478	1,395
Total sand and gravel	2,257	3,530	3,456	2,182
Grand total	8,192	10,262	9,389	9,074

[1] Figure withheld to avoid disclosing individual company confidential data, included with "Other."

[2] Includes fill (1961), glass, molding, filtering, and other construction, industrial, and ground sand.

[3] Includes railroad ballast and miscellaneous gravel.

TABLE 14.—Sand and gravel production in 1961, by counties

County	Short tons	Value	County	Short tons	Value
Ashley	114,626	$131,496	Lafayette	118,331	$193,335
Baxter	3,505	2,628	Lawrence	20,095	27,677
Benton	47,375	48,825	Lincoln	92,905	117,758
Boone	11,724	16,532	Little River	28,303	36,721
Bradley	125,915	157,395	Madison	12,285	17,322
Calhoun	841,226	829,378	Marion	18,481	22,931
Chicot	47,956	66,110	Monroe	136,782	47,873
Clarke	31,367	28,426	Montgomery	27,677	31,829
Clay	18,155	9,842	Nevada	2,707	1,083
Cleburne	105,409	36,893	Ouachita	257,639	184,107
Cleveland	37,104	52,316	Phillips	40,044	26,028
Columbia	1,442	577	Pike	38,678	34,771
Craighead	169,526	197,257	Poinsett	199,961	178,344
Crittenden	156,774	69,691	Pope	227,705	194,263
Cross	240,018	221,645	Pulaski	1,397,156	812,093
Desha	283,611	405,276	Saline	32,539	66,307
Drew	42,555	29,428	Scott	108,562	108,562
Garland	21,567	119,270	Sevier	127,473	108,352
Greene	329,935	299,213	Woodruff	8,450	11,914
Hempstead	29,399	17,639	Yell	122,933	112,805
Independence	85,109	66,922	Other Counties [1]	3,029,356	2,866,386
Izard	251,702	740,324			
Jackson	189,035	222,116	Total	9,389,068	9,074,280
Jefferson	155,971	104,620			

[1] Includes Carroll, Crawford, Hot Spring, Miller, Mississippi, and St. Francis Counties, combined to avoid disclosing individual company confidential data.

Union Counties. Quantity and value of sulfur output increased 13 and 12 percent, respectively.

TABLE 15.—**Stone sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1957	7,336	$8,871	1960	10,939	$13,555
1958	8,461	10,178	1961	12,029	12,402
1959	8,824	10,424			

METALS

Aluminum.—Production of primary aluminum continued to decline; it was 8 percent less than the 1960 output. Competition from imports and strikes in the automobile industry contributed to the decreased production and consumption of the metal.

Bauxite.—Production of crude bauxite reversed a 2-year upward trend and declined 39 percent in quantity and 34 percent in value. Arkansas bauxite output accounted for 96 percent of all U.S. production. About 96 percent of the Arkansas bauxite was mined in Saline County, and 4 percent was produced in Pulaski County, compared with 88 percent in Saline County and 12 percent in Pulaski County in 1960.

Reynolds Mining Corp., with open-pit and underground mines in Saline and Pulaski Counties, was the leading bauxite producer. Aluminum Company of America, with strip mining in Saline County, ranked second.

TABLE 16.—**Bauxite mine production and shipments from mines and processing plants to consumers**

(Thousand long tons and thousand dollars)

Year	Mine production			Shipments		
	Crude	Dry equivalent	Value	As shipped	Dry equivalent	Value
1952–56 (average)	2,003	1,695	$13,535	1,938	1,695	$14,771
1957	1,625	1,357	12,314	2,004	1,696	16,476
1958	1,517	1,258	12,311	1,588	1,348	14,373
1959	1,940	1,631	17,048	1,827	1,580	17,960
1960	2,327	1,932	20,469	1,876	1,603	18,982
1961	1,419	1,179	13,462	1,244	1,080	13,220

Manganese.—For the 2d consecutive year, no manganese was produced in the State. Mining economics and competition from imports prevented resumption of manganese mining operations by Arkansas producers.

The Federal Bureau of Mines completed its program of sampling, mapping, and estimating manganese ore reserves in Arkansas and closed its Batesville district field office transferring personnel there to Bartlesville, Okla.

TABLE 17.—Manganese ore shipped from mines[1]

Year	Short tons		Value (thousands)
	Gross weight	Mn content	
1952–56 (average)	15,065	6,687	(2)
1957	23,261	10,000	$1,726
1958	22,221	9,440	1,737
1959	17,742	6,714	1,398
1960–61[3]			

[1] Containing 35 percent or more manganese (natural).
[2] Data not available.
[3] No production in 1960 or 1961.

Zinc.—Rush Creek Mining Co. continued to mine and mill zinc ore, at a reduced rate, at its operation in southern Marion County. A small quantity of zinc concentrate was shipped to the Eagle-Picher smelter at Galena, Kans. Athletic Mining and Smelting Co. operated the Fort Smith zinc smelter at 40-percent capacity during the first 10 months of the year. Plant activity was increased to 60 percent of capacity in November.

REVIEW BY COUNTIES

Mineral production was reported in 67 of the 75 counties. Twenty-one counties reported a production value of more than $1 million. Petroleum was produced in 8 counties; natural gas in 15 counties; natural gas liquids in 3; clay in 18; coal in 5; sand and gravel in 50; stone in 30; lime in 5; recovered sulfur in 3; barite, bauxite, slate, and cement in 2; and abrasive stone, bromine, gypsum, soapstone, and zinc each in 1. Five counties—Columbia, Union, Lafayette, Saline, and Ouachita—contributed 63 percent of the mineral production value. Only those counties with significant production are discussed in this review.

Ashley.—Lime used in manufacturing paper was produced by Crossett Paper Mills at Crossett. Three companies reported production of sand and gravel for use as building and road construction material.

Benton.—Independent Gravel Co. and Ozark Construction, Inc., mined and crushed high-magnesium limestone at Sulfur Springs for agricultural fertilizer and road construction. Paul Davis and White River Sand and Gravel Co. produced sand and gravel for building, paving, and fill.

Bradley.—Petroleum and sand and gravel were the only mineral output. Value of petroleum output decreased 13 percent. Value of sand and gravel output dropped 32 percent. Moro Gravel Co. supplied sand and gravel for construction.

Calhoun.—Value of sand and gravel output was slightly more than the value of petroleum production. Five companies reported production for construction and paving projects. Petroleum output more than doubled in value over 1960.

Carroll.—Mineral production consisted of sand and gravel and crushed stone. L. G. Everist Co. and Freshour Corp. mined and crushed limestone for riprap, concrete aggregate, and roadstone. Construction of Beaver Dam west of Eureka Springs by the U.S.

TABLE 18.—Value of mineral production in Arkansas, by counties [1]

County	1960	1961	Minerals produced in 1961 in order of value
Ashley	(2)	$217,410	Sand and gravel, lime.
Baxter	$2,882	72,106	Stone, sand and gravel.
Benton	(2)	278,598	Do.
Boone	4,890	37,832	Do.
Bradley	631,110	506,483	Petroleum, sand and gravel.
Calhoun	863,256	1,653,032	Sand and gravel, petroleum.
Carroll	(2)	470,099	Stone, sand and gravel.
Chicot	351,786	66,110	Sand and gravel.
Clark	32,416	30,314	Sand and gravel, clays.
Clay	17,368	9,842	Sand and gravel.
Cleburne	1,520,824	1,267,354	Stone, sand and gravel, natural gas.
Cleveland	-----	52,316	Sand and gravel.
Columbia	29,487,180	32,083,904	Petroleum, natural gas liquids, natural gas, sand and gravel.
Conway	208,340	392,638	Stone, natural gas.
Craighead	174,528	203,932	Sand and gravel, clays.
Crawford	911,404	967,436	Sand and gravel, stone, natural gas.
Crittenden	-----	69,691	Sand and gravel.
Cross	116,065	221,645	Do.
Dallas	-----	1,035	Stone.
Desha	-----	405,276	Sand and gravel.
Drew	13,117	29,428	Do.
Faulkner	-----	77,552	Stone.
Franklin	3,097,663	3,340,841	Natural gas, coal, stone.
Garland	246,090	171,327	Sand and gravel, abrasive stone, gem stones, clays.
Grant	(2)	-----	
Greene	108,878	313,898	Sand and gravel, stone.
Hempstead	(2)	43,439	Clays, sand and gravel.
Hot Spring	3,845,481	3,850,235	Barite, clays, stone, sand and gravel, gem stones.
Howard	(2)	(2)	Cement, stone, clays, barite.
Independence	1,313,433	1,198,585	Stone, lime, sand and gravel.
Izard	(2)	(2)	Sand and gravel, stone.
Jackson	(2)	(2)	Sand and gravel.
Jefferson	49,996	(2)	Lime, sand and gravel.
Johnson	1,261,368	1,380,136	Coal, natural gas, stone, clays.
Lafayette	16,488,131	17,157,640	Petroleum, natural gas liquids, natural gas, sand and gravel.
Lawrence	133,073	365,439	Stone, sand and gravel.
Lincoln	49,537	117,758	Sand and gravel.
Little River	(2)	(2)	Cement, stone, sand and gravel, clays.
Logan	353,084	1,028,009	Stone, natural gas, coal, clays.
Lonoke	40,000	203,892	Stone, clays.
Madison	(2)	462,815	Stone, sand and gravel.
Marion	44,090	31,441	Sand and gravel, zinc.
Miller	6,793,164	6,317,993	Petroleum, sand and gravel, natural gas, clays.
Mississippi	(2)	(2)	Sand and gravel.
Monroe	-----	47,873	Do.
Montgomery	612,681	698,701	Slate, sand and gravel, barite, gem stones, clays.
Nevada	1,764,561	1,503,830	Petroleum, sand and gravel, natural gas.
Ouachita	12,534,509	11,727,172	Petroleum, sand and gravel, natural gas, lime, clays.
Perry	22,600	182,833	Stone.
Phillips	46,900	26,028	Sand and gravel.
Pike	227,153	573,086	Gypsum, sand and gravel, gem stones.
Poinsett	(2)	178,344	Sand and gravel.
Polk	30,854	33,407	Clays.
Pope	1,601,940	1,586,381	Natural gas, coal, stone, sand and gravel.
Pulaski	5,796,729	5,070,946	Stone, sand and gravel, bauxite, clays.
Randolph	-----	18,834	Stone.
St. Francis	(2)	(2)	Sand and gravel.
Saline	20,144,360	13,507,858	Bauxite, lime, sand and gravel, soapstone, slate, clays.
Scott	-----	108,562	Sand and gravel.
Searcy	-----	79,628	Stone.
Sebastian	1,470,268	1,529,054	Coal, natural gas, clays.
Sevier	-----	108,352	Sand and gravel.
Stone	(2)	-----	
Union	21,888,470	20,083,754	Petroleum, bromine, natural gas liquids, natural gas, clays.
Van Buren	-----	8,128	Stone.
Washington	586,044	289,870	Stone, natural gas.
White	(2)	(2)	Stone.
Woodruff	-----	11,914	Sand and gravel.
Yell	-----	299,128	Stone, sand and gravel.
Undistributed	23,376,777	16,366,260	
Total	[3] 158,263,000	149,138,000	

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[1] The following counties are not listed because no mineral production was reported in 1960 or 1961: Arkansas, Fulton, Lee, Newton, Prairie, and Sharp.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Army Corps of Engineers consumed most of the crushed limestone output. Garrett Gravel Co. produced sand and gravel for building and road construction.

Cleburne.—Construction of Greer's Ferry Dam near Heber Springs required 923,000 tons of crushed sandstone during the year. The stone was used for drainage blanket, riprap, and concrete aggregate. Sand and gravel for building and road construction also were produced. Value of natural gas production from the Quitman field increased slightly.

Columbia.—Value of mineral production increased more than $2.5 million. The county again led in overall mineral production value, and also ranked first in petroleum and natural gas liquids production. Arkansas-Louisiana Chemical Corp. operated its gas-processing plant at Magnolia throughout the year. The plant recovered LP gas, natural gasoline and cycle products, and sulfur. Development well drilling resulted in discovery of a new oil pool in the North Haynesville field; the new source is in the Pettet lime of Lower Cretaceous age. A minor quantity of sand and gravel was used for local building purposes.

Conway.—The county's mineral production, consisting of natural gas and crushed sandstone, rose sharply in value over that of 1960. Most of the increase was attributed to production of crushed sandstone used by the U.S. Army Corps of Engineers in constructing the Dardanelle Dam at Dardanelle.

Craighead.—Combined output of clay and sand and gravel increased 17 percent in value over 1960. Wheeler Brick Co., Inc., reported a substantial increase in clay production used in making face brick. Increased building and road construction accounted for the rise in sand and gravel output.

Crawford.—Increased production of sand and gravel and crushed sandstone was reported by Arkhola Sand and Gravel Co. The materials were used for building, paving, and fill. Development drilling accounted for discovery of two new gas sources—in the Alma and Massard Prairie fields. Natural gas production increased threefold.

Faulkner.—The county reported production of crushed sandstone and limestone. Crushed rock was used on bank-stabilization projects along the Arkansas River and on other miscellaneous construction projects. Reynolds and Williams mined and crushed limestone and sandstone; G. P. Freshour produced crushed sandstone for concrete aggregate and roadstone.

Franklin.—Value of natural gas production was $2.7 million, highest in the State. Output from the Quality Excelsior Coal Co. strip mine was enough to place the county third in coal production. Development drilling resulted in discovery of six new gas pools—three in the Ozark field, and one each in the Altus, Vesta, and White Oak fields. The county became a major supplier of natural gas in the Arkhoma Basin area.

Garland.—Value of mineral output, consisting of abrasive stones, clays, gem stones, and sand and gravel, decreased 30 percent compared with 1960. Smith Bros. Construction and Materials Co. produced sand and gravel for building purposes. Norton Pike Co. purchased novaculite, quarried near Hot Springs, for shipment to its plant in New Hampshire. Jackson Whetstone Co. mined novaculite for oilstones and whetstones. Quartz crystals and wavellite were gathered and sold as mineral specimens.

Greene.—R. D. Davenport, Ted Cline, Mississippi Valley Construction Co., and Arkansas Gravel Co. reported production of sand and gravel for building, paving, and fill. Ben M. Hogan and Co. quarried limestone for road construction.

Hempstead.—Miscellaneous clay for building brick and other heavy clay products was mined by Hope Brick Works. Sand was produced by Ideal Cement Co.

Hot Spring.—The county's leading mineral product, barite, was mined and ground by Magnet Cove Barium Corp. and by Baroid Sales Division of National Lead Co. Fire clay for refractories and heavy clay products was mined by Acme Brick Co. at its Perla Plant and by Malvern Brick and Tile Co. Acme Brick Co. mined and processed clay for building brick and tile at its Malvern Plant. Malvern Gravel Co. and Ouachita Sand and Gravel Co. procured sand and gravel for building and paving purposes. Malvern Minerals Co. mined and ground silica sand for use in finishing small cast-metal parts in liquid grinding operations. The Jones Mill aluminum-reduction plant of Reynolds Metals Co. operated throughout the year.

Howard.—Ideal Cement Co. mined chalk, clay, and marl for cement manufacture at its plant at Okay. U.S. Barite Co. mined and processed barite and sand and gravel at its plant near Dierks; however, the operation, which began in September, closed in December.

Independence.—Value of mineral production decreased 9 percent compared with 1960, largely because of declines in the output of limestone, lime, marble, and dimension sandstone. For the second consecutive year, no manganese was produced. Despite the diminished mineral output, a substantial part of the county's economy was based on mineral production. Sand and gravel production increased about fivefold in quantity and value. Batesville White Lime Co. produced hydrated lime, quicklime, and limestone for soil conditioner, metallurgical flux, asphalt filler, mineral food, and concrete aggregate. Batesville Marble Co. quarried marble for processing at its Little Rock plant. Salado Stone Co. and Bristow Stone Co. produced dimension sandstone for home and commercial building. Sand and gravel for construction and fill was furnished by Galloway Sand and Gravel Co. and McGeorge Contracting Co.

Izard.—The county continued to rank first in value of sand output and third in value of stone production. Silica Products Co., Inc., at Guion, continued production of high-grade silica sand. The ground sand was used in making glass, foundry molds, pottery, and other products. Aluminum Company of America and Arkansas Limestone Co. mined and crushed limestone at a reduced rate for metallurgical flux and soil conditioner. The combined value of mineral commodities contributed heavily to the economy of the county.

Johnson.—The county ranked second in value of coal output. Production from three underground and four strip mines supplied coal for steelmills, other industrial applications, and domestic use. Eureka Brick and Tile Co. mined miscellaneous clay for heavy clay products. Crushed sandstone was produced for riprap, road construction, and concrete aggregate by Southeast Construction Co., Inc. Exploratory drilling resulted in discovery of a new natural gas supply in the Scranton gasfield. Value of natural gas production was 34 percent greater than in 1960.

Lafayette.—The county ranked third in total value of mineral products, led in production of byproduct elemental sulfur, ranked second in output of natural gas liquids and natural gas, and was third in production of crude petroleum. McKamie Gas Cleaning Co. and Sunray Mid-Continent Co. operated plants throughout the year for recovery of LP gas, natural gasoline and cycle products, and sulfur. Exploratory and development drilling located two new sources of petroleum in the Paluxy formation in the Lewisville and Lewisville "Old Town" fields. Sand and gravel valued at $190,000 was produced for building and paving.

Logan.—Combined production value of natural gas, dimension sandstone, crushed sandstone, and coal was nearly three times that reported in 1960. Exploratory drilling discovered the Scranton gasfield in northern Logan and southern Johnson Counties. Development drilling in this field and in the Paris field increased natural gas reserves substantially by locating two additional sources of supply. Logan County Building Stone Co., Schwartz Quarry, and Rainbow Stone Co. quarried and processed dimension sandstone.

Lonoke.—Arkansas Lightweight Aggregate Corp. mined and processed clay for making lightweight aggregate. Freshour Corp. and Ben M. Hogan & Co. quarried and crushed sandstone for concrete aggregate and roadstone. The value of mineral output increased, and was attributed to production of crushed stone.

Miller.—Petroleum again was the county's most important mineral product, accounting for almost 80 percent of the total value of mineral output. Exploratory and development well drilling resulted in discovery of one oilfield and three new pools. As in 1960, Miller County ranked second in value of sand and gravel production and fourth in clay output.

Mississippi.—Elliot Sartain & Co. and Luxora Sand and Gravel Co. supplied sand and gravel for building and road construction. Construction of Interstate Highway 55 increased demand for sand and gravel.

Montgomery.—Bird and Son, Inc., quarried and processed slate for asphalt filler, roofing granules, and other uses. Production of barite, clay, gem stones, and sand and gravel also was reported.

Ouachita.—Combined production value of petroleum, natural gas, clay, sand and gravel, and lime declined 6 percent from that reported in 1960. The decrease was attributed to a decline in petroleum output. The county ranked fourth in value of petroleum production. Berry Asphalt Co. operated an oil refinery at Stephens.

Hope Brick Works produced miscellaneous clay for brick and tile manufacture at its Chidester plant. Sand and gravel value increased 32 percent.

Pike.—Dulin Bauxite Co. reported a major increase in gypsum production. Value of the output increased about threefold. Gem collectors found several diamonds in the Murfreesboro area. Sand and gravel was mined and processed for building and paving purposes.

Pope.—Mineral production consisted of natural gas, coal, stone, and sand and gravel, in order of value. Freshour Corp. and Ben M. Hogan & Co. quarried and crushed limestone and sandstone for concrete aggregate and roadstone. U.S. Army Corps of Engineers contracted for a large quantity of crushed sandstone for bank-stabilization projects along the Arkansas River. North of Russellville, Pittsburg and Midway Coal Mining Co. strip-mined coal for smelter consumption. Texas Ledgestone Co. quarried and processed dimension sandstone for domestic and commercial building uses. Exploratory drilling resulted in discovery of the New Hope gasfield in the west-central part of the county.

Pulaski.—Value of mineral output decreased 13 percent compared with 1960. Most of the decline was attributed to decreased production of clay and bauxite. A significant gain was noted in production and value of sand and gravel. Big Rock Stone and Material Co., John D. Ott, and Jeffrey Sand Co. furnished sand for building and road construction. A substantial part of the sand production was used in construction of 18 Titan missile bases north of Little Rock.

Ben M. Hogan and Co., Jeffrey Stone Co., Mid Continent Stone & Construction Co., Southeast Construction Co., Inc., and Westlake Quarry and Material Co. mined and crushed sandstone for riprap, concrete aggregate, roadstone, and railroad ballast. U.S. Army Corps of Engineers contracted for sandstone and syenite used as riprap and concrete aggregate. Big Rock Stone & Materials Co. produced syenite for roofing granules, railroad ballast, roadstone, concrete aggregate, riprap, and fill.

A. P. Green Fire Brick Co. and Stauffer Chemical Co. (Consolidated Chemical Industries Div.) mined kaolinitic clay for making refractory brick and aluminum sulfate.

Bauxite was mined, shipped, or consumed from stock by American Cyanamid Co., Campbell Bauxite Co., Porocel Corp., Reynolds Mining Corp., and Stauffer Chemical Co. Bauxite was processed for aluminum, abrasives, chemicals, and other industrial uses.

St. Francis.—Mineral production was limited to sand and gravel. J. S. Crisp Gravel Sales and St. Francis Materials Co. supplied the commodity for construction, paving and fill.

Saline.—The county produced bauxite, lime, sand and gravel, soapstone, slate, and clay, in descending order of value. Total value of the minerals declined 33 percent. A major decrease occurred in production of bauxite; however, declines in value of four of the five remaining mineral products contributed to the loss. Bauxite remained the leading mineral product. American Cyanamid, Aluminum Company of America, and Reynolds Mining Corp. mined and processed bauxite. Soapstone and slate, quarried by The Milwhite Co., Inc., was processed for filler in asphalt, insecticides, roofing, and rubber. A. P. Green Fire Brick Co. mined and processed kaolinitic clay.

Limestone from Izard County was processed into lime for use in the alumina industry by Aluminum Company of America.

Searcy.—McGeorge Contracting Co., Inc., and Reynolds and Williams quarried and crushed sandstone and limestone, respectively, for use in concrete aggregate and road-construction projects for the Arkansas State Highway Department.

Sebastian.—The county led in coal production in 1961. Output of natural gas, clay, and coal resulted in a 4-percent increase in the value of mineral output.

Seven underground and three strip mines produced more than 1,000 tons each. Coal output, produced for steelmills, gained 12 percent.

A new gas pool in the Cecil gasfield was discovered through development drilling.

Union.—Production of petroleum, bromine, natural gas liquids, natural gas, and clay was enough to rank the county second in value of mineral products in 1961. Output of petroleum—second highest in the State—contributed 93 percent of the value. Monsanto Chemical Co., Denton Corp., and Querles Oil Co. operated natural-gasoline plants. Exploratory and development drilling resulted in discovery of three new fields—Lapile, Old Union, and Pleasant Grove—and four new pools, one each in the Cypress Creek, Hibank, Nick Springs, and Smackover fields.

Michigan Chemical Corp. and Arkansas Chemicals, Inc., extracted bromine from oil-well brines at plants near El Dorado. Production of bromine from the two plants was substantially more than that reported in 1960, and it made a significant contribution to the county's economy.

Washington.—McClinton Bros. mined and crushed limestone for concrete aggregate, roadstone, and soil conditioner. Natural gas production increased slightly in quantity and value.

White.—Acme Materials Co., Inc., mined and crushed sandstone for State road construction, and for riprap, concrete aggregate, and railroad ballast.

Yell.—Freshour Bros. supplied sand and gravel for road construction. Crushed sandstone and limestone were furnished by Southeast Construction Co., Freshour Corp., Ben M. Hogan and Co., and Reynolds and Williams for riprap, roadstone and concrete aggregate.

The Mineral Industry of California

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the California Department of Natural Resources, Division of Mines and Geology.

By L. E. Davis,[1] C. D. Edgerton,[2] Roy Y. Ashizawa,[3] and L. Giorgetti[4]

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THE TOTAL value of mineral production in California rose $16.1 million in 1961 to $1,420,749,000, an increase of 1 percent. The combined value of the mineral-fuel output continued its downward trend, mainly because the yield of crude petroleum declined. Nonmetallic mineral production rose 7 percent in value above that in 1960, principally because the output and sales of sand and gravel increased. The value of metals as a group declined 8 percent; only copper and iron ore increased in either quantity or value.

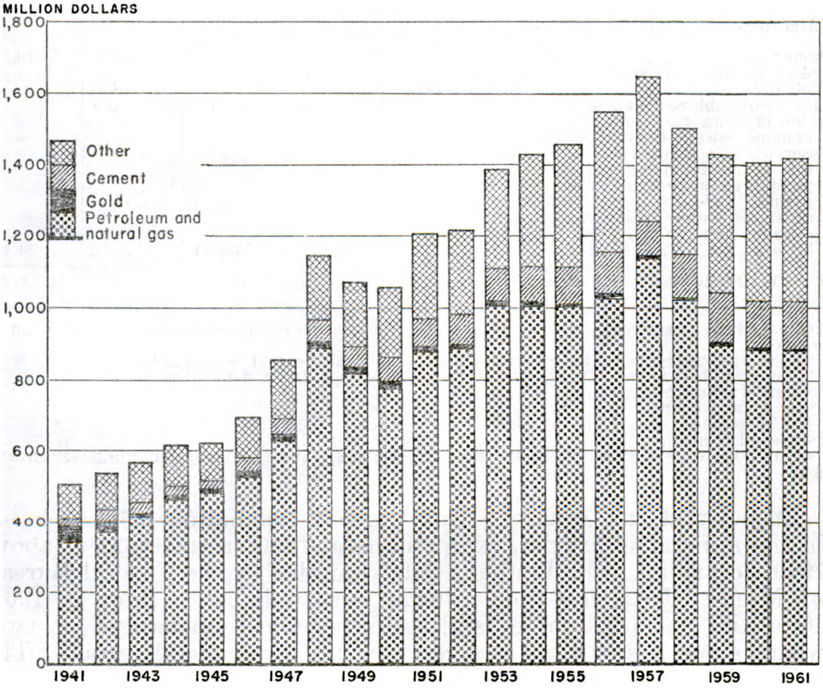

FIGURE 1.—Value of petroleum and natural gas, gold, cement and total value of mineral production in California, 1941–61.

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TABLE 1.—Mineral production in California [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite ... short tons	16,157	$181	21,203	$295
Boron minerals ... do	640,591	47,550	602,613	46,936
Cement [2] ... thousand 376-pound barrels	39,712	128,826	41,090	129,836
Clays ... thousand short tons	2,899	5,663	3,041	6,405
Copper (recoverable content of ores, etc.) ... short tons	1,087	698	1,382	829
Feldspar ... long tons	76,010	886	(3)	(3)
Gem stones	(4)	150	(4)	200
Gold (recoverable content of ores, etc.) ... troy ounces	123,713	4,330	97,644	3,418
Gypsum ... thousand short tons	1,616	3,687	1,574	3,673
Lead (recoverable content of ores, etc.) ... short tons	440	103	103	21
Lime ... thousand short tons	345	5,628	518	9,412
Magnesium compounds from sea-water bitterns (partly estimated) (MgO equivalent) ... short tons	86,532	6,233	90,534	6,467
Manganiferous ores (5 to 35 percent Mn) short tons gross weight	96	(3)	----------	----------
Mercury ... 76-pound flasks	18,764	3,955	18,688	3,693
Mica, scrap ... short tons	(3)	(3)	950	12
Natural gas ... million cubic feet	517,535	138,182	556,241	157,416
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons	794,657	62,496	762,878	57,645
LP gases ... do	408,378	21,482	424,767	21,805
Peat ... short tons	33,091	481	46,348	501
Petroleum (crude) ... thousand 42-gallon barrels	305,352	751,166	[5] 300,062	[5] 729,151
Pumice ... thousand short tons	427	1,895	610	2,202
Salt ... do	1,443	(3)	1,601	(3)
Sand and gravel ... do	87,679	107,503	110,181	124,111
Silver (recoverable content of ores, etc.) thousand troy ounces	180	163	93	86
Stone [6] ... thousand short tons	33,075	49,842	33,850	50,327
Talc, soapstone, and pyrophyllite ... short tons	130,539	1,396	161,068	1,524
Wollastonite ... do	(3)	(3)	4,075	42
Zinc (recoverable content of ores, etc.) ... do	465	120	304	70
Value of items that cannot be disclosed: Asbestos, bromine, calcium chloride, carbon dioxide, masonry cement, coal (lignite), diatomite, fluorspar, iodine, iron ore, lithium minerals, magnesite, molybdenum, perlite, platinum-group metals, potassium salts, pyrites, rare-earth metals concentrates, sodium carbonate, sodium sulfate, sulfur ore, tungsten concentrate, uranium ore, (1960), and values indicated by footnote 3	----------	[7] 79,471	----------	81,051
Total California [8]	----------	[7] 1,404,665	----------	1,420,749

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes masonry cement included with "Value of items that cannot be disclosed."

[3] Figure withheld to avoid disclosing individual company confidential data.

[4] Weight not recorded.

[5] Preliminary figure.

[6] Includes slate.

[7] Revised figure.

[8] Total adjusted to eliminate duplicating the value of clays and stone used in manufacturing cement and lime.

Employment and Injuries.—Employment (excluding officeworkers) in the mineral industries, except mineral fuels, rose 7 percent above 1960, according to preliminary data compiled by the Federal Bureau of Mines. Total lost-time injuries were well below those in 1960. Fatalities at metal mines and mills remained unchanged at two, whereas one less or eight was reported in the nonmetals group. The injury-frequency rate (number of disabling injuries per million man-hours) was 17.81 compared with 22.56 in 1960.

California participants in the Bureau of Mines 1961 National Safety Competition who reported no lost-time injuries during the year included 1 underground metal mine, 1 underground limestone quarry, 1 open-pit diatomite deposit, 1 lime plant, 12 stone quarries, and 29 sand and gravel operations.

The underground metal mine was the Pine Creek tungsten mine of Union Carbide Nuclear Co., Inyo County. This mine established a 457-day (498,941 man-hours on December 31, 1961) record without a lost-time injury. Employment in the mine during this injury-free period averaged more than 140 men. The previous safety record established by this mine had been 417 days without a disabling injury.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	Employees	Man-hours (thousands)	Injuries			Injury-frequency rate[4]
			Fatal	Nonfatal	Total	
	1960[2]					
Metal mines and mills	2, 295	4, 222	2	124	126	29. 84
Nonmetallic mines and mills	4, 197	9, 626	3	172	175	18. 18
Stone quarries	4, 729	10, 425	5	248	253	24. 27
Sand and gravel operations	5, 248	9, 454	1	206	207	21. 90
Total	16, 469	33, 727	11	750	761	22. 56
	1961[3]					
Metal mines and mills	2, 387	4, 251	2	101	103	24. 23
Nonmetallic mines and mills	4, 507	9, 389	2	214	216	23. 01
Stone quarries	4, 637	10, 275	1	159	160	15. 57
Sand and gravel operations	6, 146	11, 404	5	145	150	13. 15
Total	17, 677	35, 319	10	619	629	17. 81

[1] Excludes the mineral-fuel industry and officeworkers.
[2] Final figures.
[3] Preliminary figures.
[4] Total number of disabling injuries for the year per million man-hours.

Consumption, Trade, and Markets.—The diversity of mineral-raw-material markets exceeded that of any other State by a wide margin. In the value of raw materials consumed, California also led the nation. Despite the abundance of mineral resources, its consumption exceeded production except in those instances when California producers were the sole or principal domestic supply. The State was dependent on outside sources, foreign and domestic, for many mineral requirements, particularly mineral fuels. Foreign imports of crude petroleum rose 10 percent, and receipts from domestic producers outside the State increased 8 percent. California distributors received 5 percent more out-of-State natural gas by pipeline and plants within the State processed 3 percent more wet gas than in 1960. California ranked third in crude petroleum production in 1961, and fourth in yield of natural gas liquids and sixth in output of natural gas; however, the State surpassed all others in consumption of petroleum products and was second in use of natural gas. California had over 9 million registered motor vehicles in 1961, and

20,620 retail service stations. Twenty-eight percent of the total tax revenue came from fuels, transportation, and vehicles.

A wide variety of marketing practices was required for the diversity of metal and mineral production; over 50 percent more mineral commodities were produced than in the second-ranking State. California supplied the entire domestic output of boron minerals and compounds; it was one of two domestic sources for iodine, sulfur ore, lithium minerals and compounds, platinum-group metals, rare-earth minerals, and wollastonite. Also, California was the leading producer for seven other metal and mineral commodities and ranked second for eight more commodities. Sources within the State yielded more than half the domestic production of diatomite, iodine, mercury, sodium compounds, and sulfur ore. The 1961 output of sand and gravel was more than the combined production of the States that ranked second and third. Despite the largest output of gypsum in the Nation, a large tonnage was imported from Mexico; many nonmetal ores from deposits in neighboring States were processed in California to supply local demand. Some ore processors were also producers; others purchased or custom-milled the minerals for customers. Most metal ores and concentrates were processed out-of-State. Exceptions to this practice were the primary lead smelter and zinc fuming plant operated by American Smelting and Refining Company at Selby, Contra Costa County; the integrated steel plant of Kaiser Steel Corp. at Fontana, San Bernardino County; and the Union Carbide Nuclear Co. tungsten processing and chemical plant at Pine Creek, Inyo County.

TABLE 3.—Principal custom mills, commercial grinding plants, and primary smelters in 1961

Company	County	Nearest city or town	Minerals processed	Remarks
American Smelting and Refining Co.	Contra Costa	Selby	Lead, zinc, silver, gold.	Smelter, refinery, and fuming plant.
Fresno Agricultural Chemical Co.	Fresno	Fresno	Nonmetals	Custom mill.
Callahan Industrial Minerals Co.[1]	Inyo	Bishop	do	Do.
Union Carbide Nuclear Co.	do	Pine Creek	Tungsten ore and concentrate.	1,000-ton-a-day flotation chemical plant.
Butte Lode Mining Co	Kern	Randsburg	Gold and silver	Stamp mill, amalgamation and gravity concentrator.
American Minerals Co	Los Angeles	Los Angeles	Nonmetals	Commercial grinding.
Kennedy Minerals Co	do	do	do	Do.
Western Talc Co	do	do	do	Contract grinding.
Industrial Minerals & Chemical Co.	Sacramento	Florin	do	Do.
New Idria Mining & Chemical Co.	San Benito	Idria	Mercury	Custom mill.
Kaiser Steel Corp	San Bernardino.	Fontana	Iron ore	Blast furnaces, steel plants, and fabricating plants.
Wildberg Bros. Smelting & Refining Co.	San Francisco	San Francisco	Gold, silver, and platinum.	Smelting, refining, and manufacturing.
Metals Disintegrating Co., Inc.	Sutter	Sutter	Nonmetals	Contract grinding.

[1] Formerly operated by Huntley Industrial Minerals, Inc.

TABLE 4.—Sand and gravel, crushed stone, and portland cement sold or used in 1961, by methods of transportation

(Thousand short tons)

Material	Railroad	Motortruck	Waterway	Not stated [1]	Total
Sand and gravel (commercial)	3,389	82,657			86,046
Crushed stone (commercial)	3,422	23,779	688		27,889
Portland cement	1,433	6,209	(2)	83	7,725

[1] Includes interplant transfers to batching units, etc.
[2] Included with "Not stated" to avoid disclosing individual company confidential data.

Trends and Developments.—A number of significant developments occurred during 1961 that directly or indirectly affected the minerals industries. Seventy wells in the Wilmington field, Los Angeles County, were forced to stop pumping oil because of an earthquake in April. In March, Richfield Oil Corp. announced the first ocean-floor completion (other than tideland) of an oil well in California history. The well was completed offshore between Ventura and Santa Barbara. An offshore discovery by Richfield in the Coal Oil Point area, Santa Barbara County, prompted the laying of a pipeline system to an onshore location. The Poso Creek field, Kern County, was selected by Standard Oil Co. of California for a pilot study that required automatic gaging of between 120 and 130 wells in the field and regulation of oil shipments. In 1961, several major gas-well completions, most notable of which were two wells in the Los Medanos area, Contra Costa County, by McCulloch Oil Corp. and a well in the Lathrop field on Roberts Island, San Joaquin County, were made. Natural gas was introduced into the northern end of the 1,400-mile Alberta-California pipeline on December 2 and received at distributing facilities in the San Francisco Bay area on December 7. In October, a contract was awarded for constructing a gasoline-recovery plant at Carpenteria, Santa Barbara County; Tidewater Oil Co. purchased Honolulu Oil Co.; and Shell Oil Co. completed a new asphalt plant at its Martinez refinery, Contra Costa County. A new carbon-black plant was placed in production in August in Bakersfield, Kern County, by Continental Carbon Co.; United Carbon Co. announced beginning construction of a plant in Mojave.

Kaiser Refractories Division, Kaiser Industries, announced plans for a $1.6 million facility at Moss Landing, Monterey County that included an expansion of its basic-refractory-research program. On November 1, Callahan Mining Corp. of New York acquired the mines and processing plants of Huntley Industrial Minerals, Inc., in Inyo and Mono Counties and formed the Callahan Industrial Minerals Co. division, to operate the properties. About midyear American Potash & Chemical Corp. completed a new potash-granulation unit and new facilities to produce boric acid and anhydrous borax at its Trona plant, San Bernardino County. The American Cement Corp. white-cement plant in Crestmore, Riverside County, began producing in May; the Calaveras Cement Co. cement plant in Redding, Shasta County, was completed in December. The Bureau of Land Management received sealed bids until 10 a.m., December 15, 1961, for phosphate leases in 16 tracts on the Outer Continental Shelf, offshore from San Diego, Calif. Bid acceptance had not been announced at yearend.

Kaiser Steel Corp. announced plans for a bulk-loading facility at the Port of Long Beach; the facility was to handle 2 million tons of iron ore, petroleum coke, potash, coal, and mill-scale a year. The company reported that its 1961 steel-ingot production had passed 2 million tons on December 7; output topped 1960 total production by 300,000 tons. At yearend Iron Exploration Co. neared completion of a drilling program on the McCloud River side of Lake Shasta. New Idria Mining & Chemical Co. planned to construct in Fresno, Calif., a chemical plant that would process tungsten ore and concentrate from its Strawberry mine, Madera County. American Potash & Chemical Corp. completed arrangements with Laporte Industries, Ltd., of England for a joint operation to manufacture titanium dioxide. Installation of facilities near Mojave, Kern County, was scheduled.

TABLE 5.—Office of Minerals Exploration contracts active during 1961

County and contractor	Commodity	Contract[1]	
		Date	Total amount
Inyo: William R. Noack	Copper	Sept. 27, 1960	$29, 600
Lake: C. O. G. Minerals Corp	Mercury	July 14, 1960	35, 060
Napa: Giusti & Baker	do	June 30, 1961	17, 640
Shasta: Shasta Minerals & Chemical Co	Copper-zinc	June 10, 1960[2]	89, 620
Yolo:			
Universal Silvers, Inc.[3]	Mercury	June 16, 1958	[4]78, 770
Do	do	May 15, 1960	34, 340

[1] Government participation in each contract was 50 percent.
[2] Effective date of amendment.
[3] Formerly Trans-Pacific Metals, Inc.
[4] Original DMEA contract.

Legislation and Government Programs.—Public Land Orders issued in 1961 withdrew nearly 29,000 acres from public use, including mineral leasing. Most of this acreage was withdrawn for use by the Federal Bureau of Reclamation and the Department of Agriculture for recreational purposes, flood control, water conservation projects, and watershed studies. Also, more than 25,000 acres was restored to public use, principally along the Colorado River in Imperial County, through revocation of previous requests for withdrawal. Nearly 860,000 acres in nine counties also was restored to public use, including the right of location and entry under the general mining laws, through vacating notices. Most of this acreage was in Inyo County and had been restricted to trespass by the U.S. Navy since 1954. Twenty-three States participated in Federal payments from mineral leasing on Federal lands within their boundaries in 1961. California received $2,885,795, an increase of $177,960. Only four States received a larger payment.

During 1961, six contracts for mineral exploration in California were in force all or part of the year. Five were Office of Minerals Exploration (OME) contracts, and one was a Defense Minerals Exploration Administration (DMEA) contract under the supervision of

OME. One contract was terminated, one was canceled, and one new contract was executed during the year; one DMEA and three OME contracts were active at yearend. Eleven additional applications were received: eight for gold, and one each for molybdenum, mercury, and copper-gold. Gold, silver, iron, and other minerals were added to the program in July by amendment to OME regulations. During the remainder of the year, several hundred requests for application forms were received.

The California legislature officially changed the name of the California Division of Mines to the California Division of Mines and Geology, and changed the official title of the chief from State Mineralogist to State Geologist, effective September 15, 1961. The Federal Bureau of Mines continued its collection and dissemination of mineral production statistics in cooperation with the State agency.

Resources work in progress in California by the Bureau of Mines included examination of beryllium occurrences, the mercury potential of California (as a part of the total domestic potential), a survey of mineral raw materials for the chemical industries, and clay resources investigations. As part of a long-range program to encourage increased use of industrial minerals, reconnaissance drilling was completed on a fire-clay deposit in Stanislaus County and a high-quality-limestone deposit in El Dorado County in cooperation with the California Division of Mines and Geology. Other cooperative projects comprised determination and evaluation of underground mines and pit slopes, physical properties of semiplastic material such as borax and related minerals in Kern County, and the recovery of alumina from a large deposit of anorthosite in southern California.

Work on pure-metals development was continued at the Boulder City (Nev.) Research Laboratory in cooperation with the University of California Lawrence Radiation Laboratory (AEC). The Bureau's Berkeley Thermodynamics Laboratory conducted thermochemical studies. The basic and applied research program of the San Francisco Petroleum Research Laboratory included the following projects: Evaluation of oil-reservoir performance by electronic-computer analysis for different types of reservoirs and different well-spacing patterns, efficiency of gas displacement by natural water drive, effect of injection of foam before solvent-flooding to increase the oil-displacement efficiency of the solvent, pressure-buildup studies of gas-storage reservoirs to develop information about drainage area, rock permeability, and well-completion effectiveness, decline and forecast studies based on performance of selected California oilfields, and compatibility studies between injected sea water and interstitial waters in the Wilmington oilfield.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Carbon Black.—Shell Chemical Corp. continued to produce carbon black as a byproduct of ammonia-fertilizer manufacture at its Pittsburg plant in Contra Costa County. The product was a thermal black of large mean-particle size (4,900 angstrom units). Because of its particle size, the product was marketed chiefly for metallurgical uses. Continental Carbon Co. completed a new carbon-black plant in Bakersfield, during the year and another, for United Carbon Co., was nearing completion at Mojave at yearend. Both new plants were in Kern County.

The Continental Carbon Co. plant went on stream August 9. Two separate units were incorporated in the plant; one for the production of HAF (high abrasion furnace) black, and the other for FEF (fast extrusion furnace) black. These units used high aromatic oil as feedstock. The plant output—rated at 50 million pounds annually—was to be used mostly by the West Coast rubber industry.

The United Carbon Co. plant was scheduled for completion in May 1962 and was designed to produce five grades of carbon black. The yearly capacity was to be 64 million pounds.

Carbon Dioxide.—Carbon dioxide was produced throughout the year in a Taft, Kern County, natural-gasoline plant. In October, Tidewater Oil Co. acquired the plant from Honolulu Oil Co. Output rose 23 percent above the 1960 figure and was sold principally to aircraft companies for freezing rivets and to bottlers of carbonated beverages.

Coal (Lignite).—The only active commercial coal mine in California was the lignite strip mine of American Lignite Products Co., Inc., near Ione, Amador County. Montan wax, the chief product of the operation, was extracted by subjecting the lignite to heat and pressure. The wax was used in manufacturing carbon paper, polishes, phonograph records, and rubber. Production declined slightly in 1961.

Coke.—The main production and the consumption of coke was centered at the Fontana plant of Kaiser Steel Corp., San Bernardino County. The coking coal came mostly from company-owned mines in New Mexico and Utah, but some was purchased in Arkansas and Oklahoma. Metallurgical uses constituted the principal market for the output, which was appreciably above the 1960 total.

Natural Gas.—Drilling for natural gas was at a high rate; completions totaled 171, compared with 112 in 1960; the number of abandonments was virtually unchanged. Thirty-five gas discoveries resulted in eight new fields; the most important was the Lathrop field in the San Joaquin Valley. This field was discovered by Occidental Petroleum Corp. in October and three wells had been completed by yearend. Active development of the field was underway, and a substantial reserve was indicated.

A minimum of 774 dry-gas wells were producing in California; an additional 330 wells were potentially productive. According to the California Department of Natural Resources, Division of Oil and Gas, the net volume of gas withdrawn totaled 582,693 million cubic feet, an increase of 11 percent over 1960 withdrawals. Wet gas from oil zones supplied 65 percent of the total; the remainder was dry gas. The total gas reserve was 9,595,382 million cubic feet, of which wet gas represented 72 percent. About 260,423 million cubic feet of natural gas, including gas for repressuring and pressure-maintenance operations and for storage (45 percent of the total), was injected.

Out-of-State gas shipped into California reached a new record of 2,415 million cubic feet a day, 123 million cubic feet a day more than in 1960. Pacific Gas & Electric Co. completed a 1,400-mile natural gas pipeline from gasfields in Alberta, Canada, to the company terminal at Antioch, Contra Costa County.

TABLE 6.—Natural gas, natural gas liquids, and petroleum produced in 1961, by counties

County	Natural gas [1] (million cubic feet)	Natural gas liquids		Petroleum [1] (thousand barrels)
		Natural gasoline and cycle products (thousand gallons)	LP gases (thousand gallons)	
Butte	13,097	----------	----------	----------
Colusa	10,570	----------	----------	----------
Contra Costa	6,921	----------	----------	----------
Fresno	27,521	20,362	34,828	27,712
Glenn	27,992	----------	----------	----------
Humboldt	1,391	----------	----------	----------
Kern	124,460	205,454	158,943	92,680
Kings	15,723	(2)	(2)	1,600
Los Angeles	81,348	210,410	64,472	69,726
Madera	2,544	----------	----------	----------
Monterey	4,536	----------	----------	11,865
Orange	31,026	97,380	20,350	32,321
Riverside	----------	----------	----------	5
Sacramento	55,911	----------	----------	----------
San Benito	2,704	----------	----------	398
San Bernardino	112	----------	----------	81
San Joaquin	14,707	----------	----------	----------
San Luis Obispo	968	(2)	(2)	1,362
San Mateo	20	----------	----------	139
Santa Barbara	24,776	42,533	53,556	23,720
Solano	39,953	----------	----------	7
Sonoma	155	----------	----------	----------
Sutter	1,207	----------	----------	----------
Tehama	1,527	----------	----------	----------
Tulare	6,393	----------	----------	46
Ventura	85,810	152,933	65,209	37,947
Yolo	1,322	----------	----------	----------
Undistributed	----------	33,806	27,409	----------
Total	[3] 556,241	762,878	424,767	300,062
Value (thousands)	$157,416	$57,645	$21,805	[4] $729,151

[1] Quantity figures for natural gas and petroleum by courtesy of California Department of Natural Resources, Division of Oil and Gas.
[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[3] Less natural gas vented and wasted.
[4] Preliminary figure.

Natural Gas Liquids.—The total volume of gas processed in 1961 increased slightly; processing-plant capacity declined less than 1 percent. One new plant went on stream and 2 were shut down, reducing the number of operating plants to 69. At yearend one new plant was under construction. Production of natural gasoline and cycle products declined nearly 32 million gallons from 1960 with a proportionately lower dollar value which reflected lower prices. The output of LP gas rose 4 percent in quantity but only 2 percent in value.

Eight contiguous counties supplied the entire production of natural gasoline and cycle products, and LP gas. Kern and Los Angeles Counties yielded more than one-half the total.

Peat.—Production and sales of peat increased 40 percent over the 1960 figures. This rise was attributed to one operator, whose output doubled. There were five active operations in four counties during 1961. Approximately 80 percent of the quantity produced was reed-sedge peat from Contra Costa and Riverside Counties; 18 percent was moss peat from Modoc County; and 2 percent was peat humus from Orange County. Nearly 91 percent of the total output was marketed in California; the remainder was sold in adjacent Western States. Of the material sold, 88 percent was applied directly to the soil; the remaining 12 percent was used in mixed fertilizers, mushroom beds, golf-course maintenance, and as an ingredient in potting soils. Less than 2,000 tons was sold in the unprepared state. More than one-half of the material sold was packaged.

Petroleum.—Crude petroleum production was about 300 million barrels, 2 percent under that in 1960. The slight decline, attributed to a lesser output of light crudes (20° API or above), was not offset by the greater production of heavy crudes (below 20° API). Shut-in production came mainly from the Elk Hills field of the U.S. Navy Department.

Notices-to-drill filed totaled 2,344, an increase of 464 over the number filed in 1960. The number of new wells drilled was 2,203, of which 1,728 were completed to production and 372 were abandoned. The total footage drilled was 8,347,000 feet, averaging 3,789 feet per well. Five less exploratory wells (424) were drilled than in 1960; 61 were new discoveries; 26 were oil wells. The success ratio was 2 percent less. Nearly 283.5 million barrels of water was injected into 119 waterfloor projects in 1961, and 35 new waterflood projects were activated. One new gas-injection project was started; 3 projects were resumed; the total number of these projects was 45. More than 260 billion cubic feet of gas was injected into the 45 projects. At yearend 12 LP gas-injection projects were active. Methods used in 1961 to increase the recovery of heavy oil included the addition of diluents, the use of down-hole heaters, and the injection of steam and hot water.

Nearly 86.5 million barrels of crude petroleum, a slight decrease, was shipped into California from all outside sources. Of this volume, imports supplied 62 million barrels. Thirty-eight refineries and cracking plants were operating at yearend; the crude-oil throughput was 1,319,802 barrels daily, 1 percent less than in 1960. Cracking capacity was 518,829 barrels daily from 53 units, of which 4 were shutdown during the year. Total operating cracking capacity was 499,629 barrels daily at yearend. A second hydrocracking unit went on stream in 1961. A third unit was under construction.

NONMETALS

Asbestos.—Production and sales of chrysotile asbestos increased significantly. The principal production came from the Phoenix mine, Napa County, of Asbestos Bonding Co., Division of the Clute Corp. Shipments were made from the company processing plant to San Francisco Bay consumers for use as a cement additive and in various insulation products.

Exploration and development of asbestos deposits in the Joaquin Ridge area of the Diablo Mountain Range, Fresno and San Benito Counties was accelerated. Coalinga Asbestos Co., Inc., a joint enterprise of Johns-Manville Corp. and Kern County Land Co., developed its open-pit property and nearly completed a 12,000-ton-a-year fiber-processing plant. Hidden Splendor Mining Co. explored its asbestos claims by rotary drilling and trenching. Union Carbide Nuclear Corp. and Todd Industries, Inc., continued mine exploration and metallurgical testing of asbestos fiber found on their respective landholdings. Todd operated a processing plant in Coalinga.

Jefferson Lake Asbestos Co. completed extensive stripping at its asbestos deposit in Calaveras County in preparation for open-pit mining. An access road to the property was constructed, and erection of a mill building, a warehouse, and offices was begun in August. By yearend all steelwork on the mill building was completed. The company planned to begin mining about mid-1962.

Rawhide Asbestos Co., Tuolumne County, processed antigorite from the Chaparral Hill property in its pilot plant. The antigorite was tested, and fiber samples were prepared and shipped to prospective customers.

Barite.—Production of crude barite increased 48 percent owing chiefly to a greater demand by the oil and gas industry for ground barite suitable for use in compounding well-drilling fluids. The quantity of crude barite sold or used by producers rose 31 percent in quantity and 63 percent in value. Stocks at yearend were negligible. One mine near Barstow in San Bernardino County and two mines in the Ninemile Canyon area of Tulare County yielded more than 96 percent of the barite produced. Four other properties—one each in Mariposa, Nevada, Riverside, and San Bernardino Counties—sold small quantities of crude barite to grinders. Appreciable tonnages of crude barite mined in Nevada were processed by grinders or consumed by chemical plants in California.

Boron Minerals and Compounds.—Bedded borate deposits in Kern and Inyo Counties, and brines of Searles Lake, San Bernardino County, yielded the entire domestic supply and most of the world supply of boron minerals and compounds. Refined boron compounds were produced by United States Borax & Chemical Corp. at refineries in Kern and Los Angeles Counties, and by American Potash & Chemical Corp. and West End Chemical Co. (Division of Stauffer Chemical Co.) at plants on Searles Lake. Stauffer Chemical Co. manufactured high-purity boron compounds from purchased Kern County crude borates in a chemical plant in the San Francisco Bay area. Production declined in quantity and value, compared with 1960.

United States Borax & Chemical Corp. established a plant in Fresno, Calif., to process and distribute a borate chemical used in aerial spraying of forest and brush fires. General Services Administration purchased 6,610 tons of this chemical in 1961 for use by Government agencies, principally the U.S. Forest Service.

During the year, producers of boron compounds emphasized research into wider possible applications of their products in glass, porcelain enamel, plastics, and solid space fuels.

Bromine and Bromine Compounds.—Production of elemental bromine at the Trona plant of American Potash & Chemical Corp., San Bernardino County, was virtually unchanged from 1960. The plant product was sold to chemical and pharmaceutical companies for use in compounding a wide variety of products. Mineral Products Division, FMC Corp., recovered bromine from saltworks bitterns in its

Newark plant, Alameda County. The liquid bromine was converted to ethylene dibromide mainly for use as fumigant in treating soils and seeds. Output declined 14 percent compared with that of 1960. Most of the ethylene dibromide used in compounding antiknock fluids for gasoline was produced in other States.

The domestic capacity for producing bromine was in excess of need in 1961, principally because demand for ethylene dibromide decreased. In addition, E. I. du Pont de Nemours & Co., Inc. announced that it was seeking a site for a plant to produce 40 million pounds of this chemical a year, approximately 20 percent of the annual domestic output.

Calcium Chloride.—California Rock Salt Co. and National Chloride Co. recovered liquid calcium chloride from Bristol Lake brines, San Bernardino County. Hill Bros. Chemical Co. purchased this crude liquid and produced flake calcium chloride in a nearby plant. The products from all three plants were marketed in Arizona, Nevada, and southern California, principally in fireproofing materials and as hygroscopic agents. The quantity sold decreased 9 percent but the average value per ton was virtually unchanged from 1960.

Cement.—Production and shipments of portland cement rose 3 percent from 1960. Sales to ready-mixed-concrete companies, which purchased 66 percent of the total output, were nearly 1 million barrels greater than in 1960. Sales to structural and paving contractors increased 500,000 barrels and those to concrete products manufacturers, 250,000 barrels. The only major decrease in sales (300,000 barrels) was to building-material dealers.

Eight southern California cement plants (in Kern, Los Angeles, Riverside, and San Bernardino Counties) shipped 24,146,000 barrels; value per barrel averaged $3.11. Southern California customers received 22,638,000 barrels; Nevada, 630,000 barrels; Arizona, 445,000 barrels; and northern California, 408,000 barrels. The remaining 25,000 barrels was shipped to consumers in Colorado, New Mexico, and Utah. Bulk shipments from the 8 plants reached 20.2 million barrels, of which 14 million was transported by truck and 6.2 million, by rail. Only 3.9 million barrels was bagged for shipment, mostly by truck.

Five northern California plants (in Calaveras, San Benito, San Mateo, Santa Clara, and Santa Cruz Counties) shipped 16,944,000 barrels; value per barrel averaged $3.23. Customers in northern California received 13,931,000 barrels; southern California, 657,000 barrels; Oregon, 704,000 barrels; and Nevada, 331,000 barrels. Consumers in Alaska, Colorado, Hawaii, Washington, and foreign countries received a combined total of 1,321,000 barrels. Bulk shipments from the five plants totaled 14.3 million barrels; of which 13.2 million barrels was trucked to the destinations; and 1.1 million went by rail and ship. Bagged shipments were reported at 2.6 million barrels and were transported almost entirely by truck.

The new white-cement plant constructed by Riverside Cement Co. next to existing grey-cement facilities at Crestmore, Riverside County, was in production in May. The $5 million plant was the first in the West to be built exclusively to produce white cement and was part of the initial phase of the company's $20 million expansion and modernization program. Construction of a 1.5-million-barrel-capacity cement plant for Calaveras Cement Co. at Redding, Shasta County, was completed in December. Full-scale production was scheduled for January 1962; shipments were to begin by mid-February. California Portland Cement Co. purchased the Blue Diamond Co., Los Angeles cement mill, which was shut down in January 1961. Blue Diamond had been using purchased clinker to produce cement at the plant for its ready mixed-concrete operations in southern California.

TABLE 7.—Finished portland cement
(Thousand barrels and thousand dollars)

Year	Active plants	Estimated capacity	Production	Shipments from mills			Estimated consumption	Stocks at mills, Dec. 31
				Quantity	Value			
					Total	Average per barrel		
1952-56 (average)	11	37,248	33,865	33,785	$98,577	$2.92	29,874	1,795
1957	13	50,150	38,371	37,731	117,852	3.12	33,388	2,956
1958	13	49,505	39,056	39,583	124,367	3.14	34,232	2,483
1959	13	51,555	43,635	43,635	138,506	3.17	38,648	2,480
1960	13	51,755	39,892	39,712	128,826	3.24	35,330	2,663
1961	13	51,880	41,165	41,090	129,836	3.16	38,196	2,740

Clays.—The total quantity of clays and shale sold and used was 5 percent above the 1960 figure. Of particular interest to producers was the passage of H.R. 7057, which permitted a 15-percent-depletion allowance up to 50 percent of the selling price of finished products, not to exceed $12.50 a ton, for clay used in manufacturing the products. Of the total output, nearly 41 percent was consumed in heavy clay products; 32 percent, in portland and other cements; 20 percent, for lightweight aggregate; and the remaining 7 percent, for various industrial uses, principally refractories. Deposits in 27 counties yielded more than 2.4 million tons of miscellaneous clay and shale. Los Angeles, Napa, San Mateo, and Ventura Counties each produced more than 200,000 tons. Mines in seven counties—chiefly Amador, Placer, and Riverside—produced nearly 545,000 tons of fire clay. Kaolin was produced only in Mono and Orange Counties; ball clay, only in San Bernardino and Stanislaus Counties; bentonite, only in Inyo, San Benito, and San Bernardino Counties; and fuller's earth, only in Inyo County.

A variety of clay known as hectorite (a specific montmorillonite, which group in turn is the chief constituent of western bentonites) reportedly mined at only two operations in the world—both near Newberry, Calif.—was used to make a product used as a clarifier by the brewery and cosmetic industries. More than 2,000 tons of bentonite was used with borates in fire-retardant mixtures by Federal and State forest services to fight forest fires in California.

Several exploration projects were maintained by the Bureau of Mines under a cooperative agreement with the California Division of Mines and Geology. In the Cooperstown area of Stanislaus County, 45 holes were drilled for a total of 3,463 feet to explore a southeastern extension of the Ione clay formation. Exploratory drilling was planned for the Castle Mountain area, San Bernardino County, and for the Cherokee area, Butte County. The possibility exists that the Cherokee area is a northwestern extension of the Ione formation. A fourth area, near Acton in Los Angeles County, was sampled, and tests were conducted in the Bureau's Seattle Nonmetallics Laboratory to evaluate the material.

TABLE 8.—Clays production, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Alameda	(1)	$69,661	(1)	(1)
Amador	78,327	159,161	71,173	$143,378
Contra Costa	64,076	95,365	(1)	(1)
Inyo	8,452	45,307	5,481	33,713
Kern	65,469	122,541	(1)	126,666
Los Angeles	388,002	477,753	373,214	459,358
Madera	7,500	9,375	7,500	9,375
Orange	49,367	276,720	43,891	250,617
Riverside	370,677	1,027,511	471,365	1,301,988
Sacramento	(1)	(1)	27,964	40,471
San Bernardino	139,073	440,212	262,829	673,726
San Diego	27,100	28,650	26,500	26.500
San Joaquin	56,000	96,879	44,738	69,424
San Luis Obispo	(1)	(1)	8,873	11,091
Santa Clara	31,080	39,684	29,269	41,298
Stanislaus	(1)	38,673	6,767	47,405
Tulare	5,400	5,000	1,700	2,500
Undistributed [2]	1,608,054	2,730,106	1,660,342	3,167,479
Total	2,898,577	5,662,598	3,041,606	6,404,989

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes Calaveras, Fresno, Marin, Mono, Napa (1961), Placer, San Benito, San Mateo, Santa Cruz, Solano (1960), Sonoma, Sutter, Tuolumne (1961), Ventura, and Yuba Counties, and counties indicated by footnote 1.

Diatomite.—Most of the diatomite was produced at three open-pit operations in Santa Barbara County. Output from an open-pit mine in Fresno County was used by the producer. In Napa County diatomaceous silica produced in a previous year was processed and shipped. The quantity and value of total sales rose 4 and 7 percent, respectively, above 1960. Demand and unit value increased significantly for diatomite consumed in preparing filter aids and filler for various products. Appreciable tonnages were sold for use in insulation, pozzolan cement, and as lightweight aggregate and admixture material. In nearly all instances, the diatomite was processed at or near the pit site.

Feldspar.—Del Monte Properties Co. and Owens-Illinois Glass Co. mined the dune sands of the Monterey peninsula, chiefly for their feldspar content. The Del Monte flotation plant removed heavy minerals, produced silspar (silica-feldspar mixture), and feldspar and silica concentrates. The concentrates were blended and ground to customer specifications and sold to the manufacturers of sanitary ware, glass, pottery, soap, abrasives, and foundry products. Owens-Illinois removed heavy minerals by magnetic separation and used the feldspathic sand in manufacturing glass. The Beck feldspar mine, San Bernardino County, was idle throughout 1961.

Fluorspar.—A small tonnage of crude fluorspar was produced and processed at an open-pit mine in the Clark Mountain area, San Bernardino County. The producer suspended operations early in the year. Ceramic-grade fluorspar from the flotation plant was shipped to a glass manufacturer in Los Angeles County.

Gem Stones.—More than 80 varieties of gem materials and mineral specimens were collected in 38 counties by commercial and amateur collectors, mineralogical societies and clubs, and gem dealers. Places in San Bernardino, Kern, Riverside, and Inyo Counties yielded the greatest variety. The principal gem materials collected (in order of decreasing quantity) were agate, jasp-agate, and jasper; obsidian; kyanite; and rhodonite. Deposits in San Bernardino, Riverside, and Los Angeles Counties yielded much of the agate, jasp-agate, and jasper. Obsidian was collected chiefly from the Modoc National Forest area in Modoc County. The Bluebird mine near Ogilby, Imperial County, supplied the State's entire kyanite output. Kern and San Bernardino Counties provided noteworthy quantities of rhodonite. Specimens of nephritic jade, thulite, orphicalcite, adventurine, and diopside were obtained from the Storm-Jade Mountain mines in the Eagle Mountain area, Riverside County, reported to be the "Lost Mayan Jade mines." Collections included significant quantities of other gem materials: Actinolite, basanite, calcite, californite, jade and jadeite, lehichlorite, marcasite, nephrite, onyx, opal and opalite, petrified wood, quartz crystal, serpentine, travertine, ulexite, and verde antique.

Gypsum.—California mines yielded over 1,574,000 tons of gypsum, the largest production in the Nation; one-half the total output was produced for agricultural use. Agricultural use of gypsum declined because the potato acreage was cut back, and total sales of the agricultural grades (including mineral from out-of-State sources) was 8,000 tons less than in 1960. Deposits in Kern County yielded a high percentage of the agricultural gypsum; additional tonnages were produced in Kings, Merced, and San Luis Obispo Counties. Crude gypsum mined in Imperial, Riverside, and Ventura Counties was consumed principally in manufacturing building products and as a cement retarder. Consumption of gypsum at calcining plants in Alameda, Contra Costa, Imperial, Los Angeles, and Riverside Counties decreased 6 percent from the 1960 figure.

Iodine.—Dow Chemical Co. produced the entire 1961 domestic output of crude iodine; a high percentage was recovered from waste oil-well brines of the Los Angeles basin and was processed in the company's Seal Beach plant, Orange County. Total recovery declined 38 percent, but captive use increased 15 percent, compared with 1960. Deepwater Chemical Co., Ltd., suspended recovery at its Compton plant, Los Angeles County, and purchased crude iodine used in manufacturing various iodine compounds, particularly potassium iodide.

Lime.—Nearly 518,000 tons of lime was produced in 1961; 145,000 tons was sold, and 373,000 tons was used by the producers. Northern California plants produced 446,000 tons. Captive production included 161,000 tons of lime produced in kilns at beet-sugar and paper-pulp plants and recovered in water-treatment plants. The output of lime for chemical, refractory, agricultural, and other industrial uses increased slightly, but production for construction purposes was less than in 1960.

During the year, 19 lime plants in 13 counties operated 13 rotary kilns, 17 shaft-type kilns, and 1 multiple-hearth furnace; the combined annual lime-burning capacity was 759,000 tons. Seven plants used coke as a source of fuel; three used oil; three natural gas; six were equipped to use all three types of fuel.

Lithium Minerals and Compounds.—American Potash & Chemical Corp. recovered slightly less crude dilithium-sodium phosphate from Searles Lake brines in San Bernardino County than in 1960. The crude compound was converted to lithium carbonate before it was marketed. Much of the lithium carbonate was sold for use in compounding enamel frits because it could reduce melting temperature and improve resistance to acids and thermal shock.

Lithium contracts with the U.S. Atomic Energy Commission expired in 1960, and many lithium-producing facilities had excess capacity in 1961. American Potash & Chemical Corp. reported that it had developed a new process for making lithium tetraborate commercially, increased production of butyl lithium, and continued to evaluate a variety of organo-lithium compounds. Several aluminum companies were investigating the use of lithium compounds to increase efficiency in aluminum production.

Magnesite and Magnesium Compounds.—The output of magnesium compounds sold and used rose 5 percent above the 1960 figure. A decline in sales of magnesium carbonate and chloride was more than offset by the demand for magnesias, particularly refractory magnesia. The Mineral Products Division, FMC Corp., plants in Alameda and San Diego Counties extracted magnesium hydroxide and magnesium chloride, respectively, from saltworks bitterns obtained from nearby salt producers. Extraction plants operated by Kaiser Aluminum and Chemical Corp. in Monterey County and Merck & Co., Inc., in San Mateo County recovered magnesium hydroxide from seawater, using calcined dolomite and limestone. The Western quarry near Livermore, Alameda County, was the only active producer of magnesite. The tonnage produced and shipped was substantially below the 1960 figure. The entire output was consumed in manufacturing epsom salt.

Mica.—Production of crude mica (sericite schist) declined to less than 1,000 tons, a marked decrease from the 1960 output. A deposit near Ogilby, Imperial County, operated by C. O. Fiedler, Inc., yielded all the mica produced. The entire output was ground in the nearby company plant and sold for use in manufacturing roofing materials. A processing plant near Los Nietos, Los Angeles County, dry-ground crude scrap mica received from South Dakota and imported from India; the product was consumed by the paint and roofing industries.

Perlite.—Production of crude perlite increased substantially compared with 1960; however, shipments to expansion plants declined 17 percent. The entire production came from two deposits—one each in Inyo and Napa Counties. Purchases of crude perlite by 11 expanding plants—7 in Los Angeles County, and 1 each in Contra Costa, Fresno, Marin, and San Diego Counties—were 13 percent below those in 1960. A Napa County plant expanded perlite obtained from the nearby company-owned deposit. Out-of-State producers supplied more than one-half the crude mineral expanded in California plants. Approximately 56 percent of the expanded perlite was sold for use in building plaster; 14 percent, in filter aids; 9 percent, in wallboard; 6 percent, as lightweight concrete aggregate; and 5 percent, in soil conditioning. The rest was used for loose-fill insulation, filler, oil-well slurry, paint products, and various other industrial uses.

Potassium Salts.—Tonnage and value of potassium compounds (chloride and sulfate) increased 3 and 12 percent, respectively, and yearend stocks averaged 7 percent higher than in 1960. Except for a relatively small quantity of potassium sulfate contained in cement-plant flue dust in Santa Cruz County American Potash & Chemical Corp. extracted the entire production as muriate of potash (potassium chloride) from Searles Lake brines in Trona, San Bernardino County. Some of the muriate of potash was converted to potassium sulfate by the producer. The increased output of muriate resulted from expansion of drying facilities completed in 1961.

According to the California State Bureau of Chemistry, 3,204 tons of potassium chloride and 8,121 tons of potassium sulfate were sold for direct application to the soil; additional quantities were used to produce commercial fertilizers. Potassium compounds, chiefly potassium chloride, were exported from Los Angeles and San Diego ports to Japan, Sweden, Mexico, and the Philippine Islands.

Pumice.—Over 600,000 tons of pumice, including pumicite and volcanic cinder, was produced from 36 deposits in 12 counties. This quantity represented a 43-percent increase over the 1960 output. Crews and contractors for the California Division of Highways obtained volcanic cinder in Lassen County for road construction and repair and accounted for much of the increase. Approximately 51 percent of the 1961 output was used in road construction and maintenance; 21 percent, for lightweight concrete aggregate; 16 percent, for railroad ballast; 7 percent, for abrasives, in landscaping, and as roofing granules; the remainder was sold for use as a carrier in pesticides, as a soil-conditioning agent, as an oil and grease absorbent, and in various other industrial products. More than half the quantity sold was crude material. Prepared material was crushed, screened, and ground before shipment.

Pyrite.—The entire pyrite production came from the Iron Mountain mine of Mountain Copper Co., Shasta County. Production and shipments declined 9 and 6 percent, respectively, below 1960 figures. Chemical plants in Contra Costa County used the pyrite as a source of sulfur, and the resulting cinder was consumed in manufacturing special quick-setting cements. Mountain Copper completed more than 1,000 feet of diamond drilling at the mine and added a second car-loading facility at the railhead.

Salt.—Seven companies produced and shipped 1.6 million tons of salt, an increase of 11 percent above output in 1960. A large percentage of the output was solar salt, harvested and processed in the San Francisco Bay area. Some rock salt (halite) was mined in San Bernardino County. Leslie Salt Co., the leading producer, operated several plants in the San Francisco Bay area and began harvesting salt for the first time from ponds in the San Pablo Bay area of Napa and Solano Counties. Nearly one-half the salt output was consumed in the State. Shipments were made to all Western States (including

TABLE 9.—Pumice [1] sold or used by producers in 1961, by counties

County	Crude		Prepared		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Imperial			3, 445	$21, 015	3, 445	$21, 015
Inyo			40, 741	181, 693	40, 741	181, 693
Lake	18, 450	$46, 485	(2)	(2)	(2)	(2)
Lassen	184, 240	368, 480	(2)	(2)	(2)	(2)
Madera			6, 665	92, 336	6, 665	92, 336
Modoc	(2)	(2)	6, 735	17, 785	(2)	(2)
Shasta	43, 068	86, 136			43, 068	86, 136
Siskiyou	(2)	(2)	27, 296	63, 199	(2)	(2)
Tehama	3, 755	4, 468			3, 755	4, 468
Other counties [3]	102, 257	364, 071	173, 475	956, 788	512, 453	1, 816, 808
Total	351, 770	869, 640	258, 357	1, 332, 816	610, 127	2, 202, 456

[1] Includes pumicite and volcanic cinder.
[2] Figure withheld to avoid disclosing individual company confidential data; included with "other counties."
[3] Includes Kern, Mono, San Bernardino Counties and counties indicated by footnote 2.

Alaska and Hawaii) except New Mexico and salt was exported to Canada, Mexico, and to countries in the Far East, and Central and South America. The salt was used chiefly for chlorine and other chemical manufacturing, food preparation and preservation, and water treatment. Other applications were in manufacturing paper, rubber, and ceramics; in processing oils and metals; and in de-icing streets and highways.

Sand and Gravel.—Production of sand and gravel increased to a record 110.2 million tons valued at $124.1 million. This was a 22.5-million-ton gain over 1960 output and due principally to an accelerated highway-construction program, which required 55.5 million tons of paving sand and gravel, 15.2 million tons more than in 1960. Sand and gravel used as concrete aggregate for building construction increased more than 4.2 million tons. Los Angeles County yielded 25.3 million tons, 6.5 million tons more than in 1960, and 23 percent of the total State output. Other counties in which output exceeded 5 million tons were Tulare, Alameda, Orange, San Bernadino, and Sacramento Counties. San Diego County output was more than 5 million tons in 1960, but decreased to 4.4 million tons in 1961. The comparatively large volume of pit-run gravel produced for road base caused the average unit value for all production to decline to $1.13 per ton. Output of ground and unground industrial sands gained 6 percent and was used chiefly for blast, molding, and abrasive purposes. Sand production for glass, engine, and filter use declined slightly.

TABLE 10.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Sand		Gravel		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952-56 (average)	24, 746	$25, 460	41, 920	$40, 209	66, 666	$65, 669
1957	32, 789	34, 134	46, 194	52, 896	78, 983	87, 030
1958	30, 810	34, 710	53. 327	60, 630	84, 137	95, 340
1959	34, 101	41, 583	53. 844	67, 326	87, 945	108, 909
1960	36, 524	46, 000	51, 155	61, 503	87, 679	107, 503
1961	42, 379	51, 080	67, 802	73, 031	110, 181	124, 111

TABLE 11.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	(1)	(1)	(1)	(1)
Molding	(1)	(1)	(1)	(1)
Building	19,458	$23,622	20,446	$25,150
Paving	8,225	9,455	9,170	10,004
Blast	185	771	219	811
Engine	63	210	(1)	(1)
Filter	8	62	(1)	(1)
Other	3,366	6,060	5,004	7,135
Total	31,305	40,180	34,839	43,100
Gravel:				
Building	20,667	26,844	23,833	32,076
Paving	18,304	23,545	23,437	28,027
Railroad ballast	387	327	222	243
Other	2,370	2,414	3,715	3,707
Total	41,728	53,130	51,207	64,053
Total sand and gravel	73,033	93,310	86,046	107,153
Government-and-contractor operations: [2]				
Sand:				
Building	21	29	42	94
Paving	4,497	5,159	6,957	7,365
Fill	701	632	539	519
Other	----------	----------	2	2
Total	5,219	5,820	7,540	7,980
Gravel:				
Building	22	31	54	98
Paving	9,284	8,215	15,922	8,405
Fill	39	45	477	332
Other	82	82	142	143
Total	9,427	8,373	16,595	8,978
Total sand and gravel	14,646	14,193	24,135	16,958
All operations:				
Sand	36,524	46,000	42,379	51,080
Gravel	51,155	61,503	67,802	73,031
Grand total	87,679	107,503	110,181	124,111

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Includes figures for States, counties, municipalities, and other Government agencies.

Slag (Iron-Blast Furnace).—The Kaiser Steel Corp. Fontana steel plant generated blast-furnace slag that was expanded by its North Hollywood Block Division and used for lightweight aggregate in manufacturing building block. Mineral Wool Insulations Co. at Fontana acquired from Kaiser a comparatively large tonnage of slag, which was used for roofing granules, 43 percent; in mineral wool insulation, 28 percent; as aggregate in paving, 20 percent; and for various other industrial and construction purposes, 9 percent.

Sodium Compounds.—The quantities of sodium compounds produced and sold in 1961 increased slightly. Pittsburgh Plate Glass Co. produced anhydrous sodium carbonate (soda ash) and sodium sesquicarbonate from Owens Lake brines, Inyo County, and American Potash & Chemical Corp. and West End Chemical Division, Stauffer

TABLE 12.—Sand and gravel production in 1961, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	7,202	$11,485	Plumas	542	$496
Amador	303	1,340	Riverside	1,891	3,520
Butte	1,650	1,769	Sacramento	5,449	8,633
Calaveras	173	532	San Benito	502	454
Colusa	321	316	San Bernardino	6,133	5,321
Contra Costa	180	221	San Diego	4,368	7,820
Del Norte	290	324	San Joaquin	2,441	3,531
El Dorado	251	568	San Luis Obispo	392	463
Fresno	2,648	3,274	Santa Barbara	1,695	2,038
Glenn	354	307	Santa Clara	3,806	2,890
Humboldt	2,340	1,448	Santa Cruz	818	1,002
Imperial	1,189	1,162	Shasta	1,998	2,763
Inyo	169	174	Sierra	80	106
Kern	2,517	3,575	Siskiyou	605	587
Kings	252	252	Solano	104	138
Lake	389	365	Sonoma	2,578	2,749
Lassen	219	205	Stanislaus	903	893
Los Angeles	25,301	26,532	Sutter	219	220
Madera	316	273	Tehama	2,647	966
Marin	714	651	Trinity	279	347
Mariposa	43	62	Tulare	9,798	5,338
Mendocino	459	484	Tuolumne	68	164
Merced	1,320	1,353	Ventura	3,123	3,979
Modoc	233	190	Yolo	1,750	2,668
Mono	34	18	Yuba	436	473
Monterey	588	1,690	Other counties [1]	294	356
Napa	69	85			
Nevada	389	503	Total	110,181	124,111
Orange	6,528	6,117			
Placer	821	921			

[1] Includes Alpine, San Francisco, and San Mateo Counties, combined to avoid disclosing individual company confidential data.

Chemical Co., processed brines from Searles Lake, San Bernardino County, to produce sodium carbonate (soda ash and trona) and sodium sulfate (salt cake). The latter also produced Glauber's salt.

In Kern County, United States Borax & Chemical Corp. mined and processed borates, of which some was shipped to its Wilmington refinery, Los Angeles County, where anhydrous sodium sulfate was produced. Stauffer Chemical Co. purchased partly refined Kern County borates and recovered byproduct sodium sulfate in processing the mineral at its San Francisco plant. Output from these plants was sold in western markets only.

Stone.—Approximately 33.9 million tons of dimension and crushed stone, valued at $50.3 million, was produced during 1961. Increased quantities of crushed stone were produced at basalt, granite, and limestone quarries for concrete and roadstone. The output of riprap increased because of the large tonnages of granite and limestone used at hydroelectric power and flood-control projects in El Dorado and Tulare Counties. The 1960 completion of several heavy construction projects, which utilized riprap from nearby sandstone and miscellaneous stone deposits, resulted in less output of these materials. Notable gains were reported by producers of limestone for cement, lime, sugar, glass, paper, and whiting, and of limestone and quartzite quarried for agricultural, chemical, and refractory uses. Granite and limestone produced for use as rubble and as rough and dressed building stone represented much of the greater output of dimension stone. The markets for roofing slate from Mariposa County and for crushed and ground slate granules and flour from El Dorado County were better than in 1960. Producers at marble deposits in Inyo, San Bernardino, and Tuolumne Counties quarried and processed substantially larger quantities of stone for building exteriors, terrazzo, and roofing granules. The tonnage of natural and artificially colored roofing granules, prepared from crushed stone, gravel, slag, and volcanic cinder, increased from 404,000 tons in 1960 to 428,000 tons.

TABLE 13.—Stone sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble......short tons..	45,270	$842,795	83,458	$729,930
Rough architectural......cubic feet..	[1] 74,607	[1] 504,239	[1] 134,879	[1] 704,865
Approximate equivalent in......short tons..	6,240	------------	11,220	------------
Monuments and mausoleums......cubic feet..	22,728	289,431	36,767	289,240
Approximate equivalent in......short tons..	1,959	------------	3,093	------------
Flagging......cubic feet..	19,667	50,716	22,197	51,312
Approximate equivalent in......short tons..	1,657	------------	1,856	------------
Total dimension stone, approximate short tons......	55,126	1,687,181	99,627	1,775,347
Crushed and broken stone:				
Riprap......short tons..	4,942,054	6,611,511	5,108,014	7,446,743
Metallurgical......do....	(2)	(2)	(2)	(2)
Concrete and roadstone......do....	10,659,927	13,153,995	11,483,138	14,441,914
Railroad ballast......do....	(2)	(2)	(2)	(2)
Agricultural......do....	(2)	(2)	(2)	(2)
Chemical......do....	(2)	(2)	25,955	249,148
Miscellaneous [3]......do....	[4] 17,417,742	[4] 28,389,377	[5] 17,133,468	[5] 26,413,419
Total crushed and broken stone......do....	33,019,723	48,154,883	33,750,575	48,551,224
Grand total, approximate short tons......	33,074,849	49,842,064	33,850,202	50,326,571

[1] Includes dressed architectural, roofing slate, and millstock (1961).

[2] Included with "Miscellaneous" to avoid disclosing individual company confidential data.

[3] Includes whiting substitute, filler, mineral food, poultry grit, stucco, roofing granules, filter beds, terrazzo, metallurgical, railroad ballast, agricultural, chemical, and miscellaneous uses.

[4] Includes 11,878,047 short tons of limestone and oystershell used in cement valued at $14,670,521 and 726,876 tons of limestone used in lime valued at $1,974,004.

[5] Includes 12,035,463 short tons of limestone and oystershell used in cement valued at $13,305,490 and 742,458 tons of limestone used in lime valued at $2,006,600.

Sulfur.—Elemental sulfur was recovered as a byproduct of oil refining at four plants—two in Los Angeles County, and one each in Contra Costa and San Luis Obispo Counties. A chemical plant near Long Beach, Los Angeles County, received hydrogen sulfide gas from a refinery at Watson and recovered the contained sulfur. Recovery from all sources was virtually unchanged from 1960, but shipments declined 11 percent. The Long Beach chemical plant used the Simon-Carves process to extract sulfur from the gas; all other refineries employed the Modified Claus method. Output of hydrogen sulfide rose 12 percent, based on sulfur content. Recovery of liquid sulfur dioxide from stack gases at the American Smelting and Refining Co. Selby smelter, Contra Costa County, was essentially the same as in 1960.

Sulfur-ore production came principally from The Anaconda Company Leviathan mine, Alpine County. The crude ore was stockpiled for use at the company sulfuric acid plant in Nevada. Active during the year and producing sulfur used in soil treatment were Crater Sulphur mine, Inyo County, and the S Bar S and Sulphur Bank mines, Lake County. The quantity and value of sulfur ore shipments were slightly lower than in 1960.

TABLE 14.—Stone [1] production in 1961, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	2,072	$1,479	Riverside	1,409	$3,568
Alpine	1	2	Sacramento	2	2
Butte	631	674	San Bernardino	4,727	7,291
Contra Costa	2,088	2,951	San Diego	1,027	1,763
Del Norte	52	60	San Joaquin	36	50
El Dorado	1,645	3,470	San Luis Obispo	159	(2)
Fresno	137	261	San Mateo	1,871	2,280
Glenn	31	32	Santa Barbara	(2)	720
Humboldt	184	384	Santa Clara	3,970	2,957
Imperial	2	2	Santa Cruz	1,449	2,020
Inyo	(2)	482	Shasta	103	102
Kern	(2)	4,414	Siskiyou	71	76
Lake	11	19	Sonoma	215	328
Lassen	18	30	Stanislaus	2	2
Los Angeles	1,175	1,910	Sutter	47	71
Madera	11	404	Tehama	89	64
Marin	897	1,664	Trinity	10	14
Mariposa	263	602	Tulare	1,514	1,600
Mendocino	77	143	Tuolumne	156	(2)
Merced	(3)	(4)	Ventura	371	843
Orange	64	172	Other counties [5]	7,238	7,151
Placer	25	270	Total	33,850	50,327

[1] Includes stone used in cement and lime.
[2] Included with "Other counties" to avoid disclosing individual company confidential data.
[3] Less than 1,000 short tons.
[4] Less than $1,000.
[5] Includes Amador, Calaveras, Monterey, Napa, Nevada, Plumas, San Benito, San Francisco, Sierra, Solano, and counties indicated by footnote 2.

TABLE 15.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Granite		Basalt and related rocks (traprock)		Limestone [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1957	12,744	$10,565	1,953	$2,432	14,102	$22,512
1958	3,649	5,348	1,499	1,738	14,409	22,584
1959	4,343	5,433	1,772	2,728	16,137	24,384
1960	4,208	5,409	1,941	2,748	15,054	23,311
1961	4,867	7,233	1,880	2,225	16,669	23,989
	Sandstone		Other stone [2]		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1957	4,222	$6,680	8,330	$11,402	41,351	$53,591
1958	3,933	5,688	8,933	12,987	32,423	48,345
1959	2,758	4,506	7,124	12,039	32,134	49,090
1960	3,541	5,626	8,331	12,748	33,075	49,842
1961	3,286	5,222	7,148	11,658	33,850	50,327

[1] Includes limestone and oystershell used in cement and lime as follows (in thousand short tons and thousand dollars): 1957, 11,861 tons, $16,489; 1958, 12,352 tons, $16,422; 1959, 13,663 tons, $16,628; 1960, 12,605 tons, $16,645; 1961, 12,778 tons, $15,312.
[2] Includes light-colored volcanics, schist, serpentine, river boulders, and such other stone as cannot properly be classed in any main group; also marble (1957-61) and slate (1958-61).

Talc, Soapstone, and Pyrophyllite.—Production of these minerals rose 23 percent above the 1960 tonnage, and sales to consumers increased 10 percent; however, shipments to grinders declined 4 percent. Eighteen deposits in Inyo County and 15 in San Bernardino County supplied the State talc output, which represented about 62 percent of the total production for all three minerals. Soapstone was mined from four properties—two in Amador County; and one each in El Dorado and Los Angeles Counties. Three mines in San Diego County and one each in Mono and San Bernardino Counties yielded the entire pyrophyllite output. Approximately 51 percent of total shipments was consumed in the ceramic industry. The other major uses were as a filler in paint and a carrier in insecticides. Of the three minerals, only talc was reported to have been exported in 1961.

Vermiculite.—In Orange County, Lahabralite Co. exfoliated crude vermiculite imported from Africa, and California Zonolite Co. exfoliated crude vermiculite received from company mines in Montana at plants in Sacramento and Los Angeles Counties. Plant products were used for insulation (thermal and acoustical), as lightweight aggregate in concrete and plaster, and as a soil conditioner. The quantities sold rose above the 1960 figure, but the average unit value declined slightly because of the comparatively larger tonnages of lower grade mineral consumed by the agriculture industry. A vermiculite prospect in the Crystal Peak area, Plumas County, was idle throughout 1961.

Water.—Successful operation of the Pacific Gas and Electric Co. 12,500-kilowatt Geysers Tower geothermal electric power-generating plant, Sonoma County, was the basis for a decision to build a second unit of equal capacity adjacent to the first. Construction of the new unit was to begin in 1962.

During 1961, Magma Power Co. and associated companies completed two new steam wells in the Mammoth area, Mono County, and deepened an existing well in the Sulphur Bank area, Lake County. The O'Neill Geothermal Co. of Midland, Tex., investigated the Salton Sea area, Imperial County, as a source for geothermal power. It drilled a new well in the area to a depth of 5,000 feet.

Construction of the 1-million-gallon-a-day sea-water-conversion plant at Point Loma, San Diego County, a cooperative venture by the Office of Saline Water, the California Department of Water Resources, and the city of San Diego, neared completion, and operation was expected early in 1962. Late in December the Office of Saline Water awarded FMC Corp. of San Jose, Calif., a contract to build a 4,600-gallon-a-day vapor-reheat distillation pilot plant, using liquid-heat exchangers as a method of converting salt water to fresh water. On the last day of the year the Secretary of the Interior approved an agreement with the State of California for Federal construction of the $433 million Federal-State San Luis Unit of the Central Valley Project, northwest of Fresno.

Other Nonmetals.—Phosphate rock purchased from Idaho producers and pebble phosphate rock from Florida were used by California chemical companies to manufacture phosphoric acid, nitrophosphates and nitrosulfates, and single superphosphate and ammonium phosphate fertilizers. Total consumption of the crude phosphates rose nearly 9 percent. Late in the year the Federal Bureau of Land Management asked for bids to lease 80,000 acres of phosphate-bearing land submerged in 600 feet of water about 40 miles of the coast of southern California. Only one bid, from Collier Carbon & Chemical Co. which offered more than $120,000 for over 30,000 acres, was received. The lease was to run for 10 years.

The Alameda County plant of C. K. Williams Co. prepared all the iron oxide pigments produced in the State. Although a high percentage of the total output was manufactured brown, red, and yellow iron oxides, the company used hematite and limonite received from out-of-State sources to produce natural brown iron oxide, venetian red, ocher, sienna (raw), and umber (raw) pigments. Raw sienna and umber pigments were new at this plant in 1961.

The Desert Rat aluminum silicate claims near Daggett, Riverside County, were idle except for annual assessment work. However, the owners constructed a mill and installed a reduction furnace for testing the silicate in preparing for a marketing program.

In the Midland area, east of Daggett, wollastonite float was gathered by several operators, who shipped the mineral for decorative building and landscaping use.

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Beryllium.—The Federal Bureau of Mines continued to investigate beryllium occurrences, but little activity was reported by property owners. The White Caps Gold Mining Co. of Nevada was active in underground exploration at the Sorenson beryllium prospect about 8 miles south of Lone Pine, Inyo County. Some exploration was done on the beryl-bearing pegmatites at the Ruby claims north of Jacumba, San Diego County.

Copper.—Six copper mines and prospects were active. However, 98 percent of the total recoverable copper was obtained from copper concentrate produced from ores at the Copper Bluff mine, Humboldt County, and as a byproduct from treating tungsten ores of the Pine Creek mine, Inyo County. Only one other mine, the Engels copper mine in Plumas County, yielded an appreciable quantity of copper during the year. Despite the low level of activity, the quantity and value of copper output in the State was the largest in 14 years.

Gold.—The value of gold production in California was the lowest in more than 100 years. Over 86 percent of the output was of placer origin, principally from dredging operations in Yuba and Sacramento Counties. Dredging operations were marginal and gold recovery was 9 percent below that of 1960.

Lode-gold output declined 58 percent and came from 79 mines compared with 83 in 1960. Mines classified as lode-gold mines increased from 53 to 56, but output from these mines declined 69 percent. About 99 percent of the total lode-gold recovered came from gold and copper ores.

TABLE 16.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Alpine	1		10	$350	56	$52
Amador	1	(2)	11	385	1	1
Butte	2	2	53	1, 855	8	7
Calaveras	2	2	141	4, 935	22	20
El Dorado		(2)	71	2, 485	5	5
Fresno		3	338	11, 830	45	42
Humboldt	1		4, 498	157, 430	42. 765	39, 536
Inyo	11		142	4, 970	(3)	(3)
Kern	6	(2)	238	8, 330	1, 509	1, 395
Mariposa	7	5	529	18, 515	(3)	(3)
Merced		1	59	2, 065	5	5
Nevada	5	4	479	16, 765	126	116
Placer		4	170	5, 950	20	18
Plumas	3	2	88	3, 080	1, 098	1, 015
San Bernardino	9	(2)	35	1, 225	498	460
San Diego	3		49	1, 715	7	6
San Joaquin			4	140		
Shasta	4	3	176	6, 160	59	55
Sierra	7	2	7, 216	252, 560	1, 463	1, 353
Siskiyou	6	8	235	8, 225	106	98
Stanislaus		1	24	840	2	2
Trinity	2	7	102	3, 570	9	8
Tuolumne	4	(2)	55	1, 925	7	6
Undistributed [4]	5	4	82, 921	2, 902, 235	45, 540	42, 102
Total	79	48	97, 644	3, 417, 540	93, 351	86, 302

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$402
Amador							386
Butte							1, 862
Calaveras							4, 955
El Dorado							2, 490
Fresno							11, 872
Humboldt	1, 451, 700	$435, 510	52, 500	$5, 408	573, 500	$65, 952	703, 836
Inyo	(3)	(3)	142, 300	14, 657	31, 800	3, 657	23, 284
Kern							9, 725
Mariposa							18, 515
Merced							2, 070
Nevada	(3)	(3)					16, 881
Placer							5, 968
Plumas	43, 200	12, 960	(3)	(3)	(3)	(3)	17, 055
San Bernardino	6, 100	1, 830	6, 100	628	200	23	4, 166
San Diego							1, 721
San Joaquin							140
Shasta							6, 215
Sierra							253, 913
Siskiyou	100	30					8, 353
Stanislaus							842
Trinity							3, 578
Tuolumne							1, 931
Undistributed [4]	1, 262, 900	378, 870	5, 100	525	2, 500	288	3, 324, 020
Total	2, 764, 000	829, 200	206, 000	21, 218	608, 000	69, 920	4, 424, 180

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[2] From property not classed as a mine.

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[4] Includes Los Angeles, Mono, Sacramento, and Yuba Counties and counties indicated by footnote 3.

TABLE 17.—Gold produced at placer mines, by classes of mines and methods of recovery [1]

Class and method	Number of mines producing [2]	Number of washing plants (dredges)	Material treated (thousand cubic yards)	Gold recovered: Troy ounces	Gold recovered: Value	Gold recovered: Average value per cubic yard
Surface placers: Gravel mechanically handled:						
Bucketline dredges:						
1952–56 (average)	4	13	43,498	131,621	$4,606,721	$0.106
1957	3	9	31,043	117,832	4,124,120	.133
1958	3	7	27,513	135,540	4,743,900	.172
1959	2	7	24,528	103,023	3,605,805	.147
1960	2	5	21,020	89,562	3,134,670	.149
1961	2	5	23,651	82,316	2,881,060	.122
Dragline dredges:[3]						
1952–56 (average)	8	7	478	2,103	73,612	.154
1957	4	4	261	759	26,565	.102
1958	6	6	83	467	16,345	.197
1959	6	6	119	1,405	49,175	.413
1960	13	14	111	1,081	37,835	.340
1961	3	3	493	309	10,815	.022
Suction dredges:						
1952–56 (average)	5	5	38	154	5,404	.141
1957	--------	--------	--------	--------	--------	--------
1958	2	2	2	14	490	.223
1959	3	3	7	68	2,380	.359
1960	2	2	(4)	5	175	.583
1961	5	5	64	22	770	.012
Nonfloating washing plants:[3] [5]						
1952–56 (average)	20	21	29	1,678	58,744	2.041
1957	4	21	12	1,549	54,215	.970
1958	4	15	1	872	30,520	.523
1959	3	11	2	1,201	42,035	.326
1960	2	6	8	365	12,775	.376
1961	6	9	340	557	19,495	.039
Gravel hydraulically handled:						
1952–56 (average)	9	--------	88	289	10,108	.116
1957	6	--------	11	85	2,975	.271
1958	6	--------	7	166	5,810	.824
1959	3	--------	4	50	1,750	.417
1960	4	--------	1	11	385	.396
1961	2	--------	2	3	105	.050
Small-scale hand method: [6]						
1952–56 (average)	40	--------	84	1,372	48,020	.664
1957	32	--------	36	1,283	44,905	1.246
1958 [7]	39	--------	49	1,177	41,195	.841
1959 [7]	22	--------	30	1,146	40,110	1.405
1960 [7]	26	--------	59	1,111	38,885	.617
1961	27	--------	17	1,105	38,675	.324
Underground placers: Drift:						
1952–56 (average)	13	--------	4	172	6,013	1.503
1957	6	--------	3	109	3,815	1.240
1958	5	--------	(4)	27	945	2.796
1959	3	--------	(4)	9	315	1.432
1960	1	--------	1	44	1,540	1.750
1961	3	--------	1	55	1,925	1.250
Grand total placers:						
1952–56 (average)	99	--------	44,219	137,389	4,808,622	.109
1957	55	--------	31,366	121,617	4,256,595	.133
1958	65	--------	27,655	138,263	4,839,205	.173
1959	42	--------	24,691	106,902	3,741,570	.152
1960	50	--------	21,201	92,179	3,226,265	.152
1961	48	--------	24,570	84,367	2,952,845	.119
1848–1961	--------	--------	(8)	68,047,637	1,517,404,941	(8)

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[1] For historical data by years, see Minerals Yearbook, Review of 1940, p. 219.

[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[3] Includes commercial rock plants and tungsten mines that produced byproduct gold from gravels; byproduct gold is included with gold recovered, but material treated and average value per cubic yard refer only to straight gold dredging.

[4] Less than 1,000 cubic yards.

[5] Includes all placer operations using power excavator and washing plants both on dry land; when the washing plant is a movable outfit, it is termed "dry-land dredge."

[6] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long tons.

[7] Includes gold recovered by electrostatic separation; combined to avoid disclosing individual company confidential data.

[8] Data not available.

TABLE 18.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing [2]		Material sold or treated [3] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
1952-56 (average)	134	99	327	235,241	$8,233	867,585	$785
1957	118	55	204	170,885	5,981	522,288	472
1958	107	65	139	185,385	6,489	188,260	170
1959	73	42	142	145,270	5,084	172,810	156
1960	83	50	157	123,713	4,330	179,780	163
1961	79	48	46	97,644	3,418	93,351	86
1848-1961	-------	--------	(4)	105,802,291	2,405,184	119,017,731	96,933

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	603	$401	8,019	$2,398	6,215	$1,710	$13,529
1957	945	569	3,458	989	2,969	689	8,700
1958	749	394	140	33	51	10	7,096
1959	663	407	227	52	78	18	5,717
1960	1,087	698	440	103	465	120	5,414
1961	1,382	829	103	21	304	70	4,424
1848-1961	638,770	208,388	263,421	52,362	150,253	35,472	2,798,339

[1] Includes recoverable metal content of gravel washed (placer operations); ore milled; old tailings or slimes retreated; tungsten ore; and ore, old tailings, slag, flue dust, and pyritic ore residue shipped to smelters during calendar year indicated.

[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[3] Does not include gravel washed.

[4] Data not available.

TABLE 19.—Mine production of gold, silver, copper, lead, and zinc, in 1961, by types of material processed and methods of recovery, in terms of recoverable metals [1]

Type of material processed, and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation: Ore	6,950	1,317	------------	------------	------------
Cyanidation:					
Ore	----------	----------	------------	------------	------------
Old tailings	36	30	------------	------------	------------
Total	36	30	------------	------------	------------
Total recoverable in bullion	6,986	1,347	------------	------------	------------
Concentration and smelting of concentrates: Ore [1] [2]	6,098	80,531	2,740,100	57,500	573,500
Direct smelting:					
Ore	134	6,156	23,900	148,500	34,500
Old tailings	59	24	------------	------------	------------
Total	193	6,180	23,900	148,500	34,500
Placer	84,367	5,293	------------	------------	------------
Grand total	97,644	93,351	2,764,000	206,000	608,000

[1] Includes gold recovered as "natural gold."

[2] Includes tungsten-ore concentrate.

TABLE 20.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Gold	56	24,134	8,504	2,161	----------	----------	----------
Silver	3	13	8	1,232	400	200	----------
Copper and tungsten ore [2]	6	[3] 19,449	4,607	79,820	2,759,400	52,500	573,500
Lead	11	1,720	31	4,244	2,600	140,100	13,100
Lead-zinc	2	55	3	369	1,000	13,100	19,000
Zinc	1	14	28	178	600	100	2,400
Total	79	45,385	13,181	88,004	2,764,000	206,000	608,000
Other lode material: Old tailings	(4)	516	96	54	----------	----------	----------
Total lode material	79	45,901	13,277	88,058	2,764,000	206,000	608,000
Gravel (placer operations)	48	(5)	84,367	5,293	----------	----------	----------
Total all sources	127	----------	97,644	93,351	2,764,000	206,000	608,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Tungsten-ore tonnage not included.
[4] From property not classed as a mine.
[5] 24,671,750 cubic yards. Does not include material washed at commercial gravel plants to produce 378 ounces of byproduct gold and 32 ounces of byproduct silver included in placer totals.

Iron Ore.—Mine production of iron ore increased 85 percent above 1960; nearly all was upgraded at concentrators before it was shipped. The value of shipments was the highest since 1957. Except for a few tons of underground ore stockpiled at the Storm-Jade mine, Riverside County, iron ore was mined entirely from open pit operations. Three iron mines—one in San Bernadino County and two in Shasta County—yielded all the direct shipping grade ore, a tonnage nearly 4 times the 1960 figure. Mine-run ores from two properties—one each in Riverside and San Bernadino Counties—were upgraded at company beneficiation plants. Although an appreciable quantity was exported and a comparatively small tonnage was sold to cement manufacturers, most of the concentrates produced were consumed in California iron and steel furnaces. Soon after midyear, Kaiser Steel Corp. negotiated a 10-year contract with Mitsubishi Shoji, Ltd., of Japan, for the sale of 10 million tons of iron ore. Shipments of 1 million tons a year were to begin late in 1962 from the Eagle Mountain mine, Riverside County. During 1961, the port of Stockton received 628,735 long tons of iron ore from California and Nevada producers, about 50,000 tons less than in 1960. Virtually all the iron ore was exported to Japan.

Iron Exploration Co. (a joint venture of Bunker Hill Co., Morrison-Knudsen Co., W. R. Grace & Co., and Hydrocarbon Research, Inc.) conducted a drilling program during 1961 on the Shasta and California Consolidated iron claims on the McCloud River side of Lake Shasta. This area was the site of Bureau of Mines exploration in 1944, when five holes were drilled.

Iron and Steel Scrap.—Consumption of ferrous scrap at California furnaces rose 10 percent above that of 1960. The Fontana plant of Kaiser Steel Corp. and the Pittsburg and Torrance plants of United States Steel Corp. used pig iron in addition to home-generated and purchased scrap in making steel. All other steel furnaces used 100-percent scrap. Home-generated and purchased scrap increased 9 and 5 percent, respectively. Exports of ferrous scrap increased markedly. Shipments to Japan alone were 79 percent above those of 1960. Scrap prices closed the year somewhat higher, particularly for those products most in demand. No. 1 heavy-melting scrap was up $4 at Los Angeles and $2 at San Francisco from the same period in 1960. No. 2 bundles, major product from the scrap yards, closed $3 to $4 higher at Los Angeles, and $2 higher at San Francisco.

TABLE 21.—Ferrous scrap and pig iron consumption

(Thousand short tons)

Year	Ferrous scrap	Pig iron	Year	Ferrous scrap	Pig iron
1952-56 (average)	2,559	1,235	1959	2,280	1,379
1957	2,656	1,437	1960	2,054	1,650
1958	2,127	1,280	1961	2,250	2,192

TABLE 22.—Ferrous scrap and pig iron, consumption by types of furnaces and miscellaneous uses

(Thousand short tons)

Ferrous scrap and pig iron charged to—	1960	1961	Ferrous scrap and pig iron charged to—	1960	1961
Steel furnaces: [1]			Miscellaneous uses: [3] Scrap	47	42
Scrap	1,670	1,876			
Pig iron	1,340	1,740	Total scrap	2,054	2,250
			Total pig iron	1,650	2,192
Total	3,010	3,616			
			Grand total	3,704	4,442
Iron furnaces: [2]					
Scrap	337	332			
Pig iron	310	452			
Total	647	784			

[1] Includes open-hearth, electric furnaces, and basic oxygen process.
[2] Includes cupola, air, and blast furnaces; also direct castings.
[3] Includes rerolling, copper precipitation, nonferrous, and chemical uses.

Lead.—Recoverable lead output decreased more than 75 percent. The principal production came from lead and lead-zinc ores mined in Inyo County (69 percent) and copper ore in Humboldt County (25 percent). The remainder (6 percent) was recovered from all other lode sources combined.

Mercury.—Five less mercury mines were active than in 1960. Although production was virtually unchanged, the number of flasks of mercury shipped to buyers and consumers declined 4 percent in a market that averaged $15 a flask less. Over 92 percent of the mercury output was recovered in treating ores mined at five operations—the New Idria mine, San Benito County; the Buena Vista Mine, San Luis Obispo County; the Great Eastern (Mt. Jackson) mine, Sonoma County; the New Almaden mine, Santa Clara County; and the Reed mine, Yolo County. These five operations yielded more than 1,000 flasks, each. Only 10 properties in the State yielded 100 or more flasks.

TABLE 23.—Mercury production, by methods of recovery

Year	Operating mines	Furnaced[1]		Retorted		Unclassified[2] flasks	Total	
		Ore (short tons)	Flasks	Ore (short tons)	Flasks		Flasks	Value[3]
1952–56 (average)	41	97,588	8,411	5,638	863	63	9,337	$2,284,679
1957	57	115,134	13,722	10,806	2,228	561	16,511	4,077,887
1958	48	130,560	20,307	10,471	1,594	464	22,365	5,122,927
1959	37	107,072	15,685	12,034	1,271	144	17,100	3,889,908
1960	41	120,714	17,862	4,334	785	117	18,764	3,954,701
1961	36	118,264	17,776	2,431	883	29	18,688	3,692,936

[1] Includes ore and mercury from dumps not separable.
[2] Includes mercury recovered from miscellaneous dump material, placer, and cleanup operations.
[3] Value calculated at average New York price.

Molybdenum.—Combined production and shipments of molybdenite and powellite concentrates decreased 33 and 43 percent, respectively. Both minerals were obtained as byproducts in treating tungsten ores at the Pine Creek mine, Inyo County. About 92 percent of the molybdenite and 26 percent of the powellite shipments were consigned for export; the remainder was sold to domestic consumers. Yearend stocks increased 17 percent.

Pig Iron.—Kaiser Steel Corp. at Fontana, San Bernardino County, was the only pig-iron producer; however, United States Steel Corp. (Columbia-Geneva Division) received pig iron from its blast furnaces in Utah at its furnaces in Pittsburg, Contra Costa County, and in Torrance, Los Angeles County. Production, shipments, and consumption of pig iron exceeded 1960 figures by 38, 41, and 33 percent, respectively. Erection of the Pacific States Steel Corp. blast furnace at Niles, Alameda County, was at a standstill in 1961. Bethlehem Steel Corp. announced the successful completion of its experimental H-iron program about midyear. All necessary data were obtained, and no further operations were scheduled at the company H-iron plant in the Los Angeles area. Further exploitation of the process was to be dependent upon the need for primary iron-production facilities. The proposed automated plant of Jaffe Steel Co. (formerly American Steel Rolling Mills, Inc.) for making reinforcing rod did not materialize. The planned stainless-steel plant of New Pacific Rolling Mills, Inc, was abandoned soon after construction was begun.

Platinum-Group Metals.—Two major dredging operations, one each on the Yuba and American Rivers, obtained platinum as a byproduct of gold recovery. The former reported less yield than in 1960, despite a greater yardage of gravel washed.

Rare-Earth Minerals.—Output from the Mountain Pass barite-bastnaesite mine of Molybdenum Corporation of America, San Bernardino County, decreased 40 percent, but shipment of bastnaesite concentrate were only slightly less than in 1960. Late in 1961, the company signed a long-term contract with Davison Chemical Division, W. R. Grace & Co., whereby it would supply rare-earth concentrates to Davison for the preparation and sale of cerium oxide polishing compounds used in the glass industry.

Silver.—The quantity of silver recovered from all sources declined 48 percent below the 1960 total. Production of placer silver, a coproduct of placer gold mining, declined 6 percent and represented only 6 percent of the total silver output. The major decline was in lode silver output, where over 90 percent was a byproduct of copper and tungsten ores.

Tungsten.—Only two tungsten mines were active. The Pine Creek operation of Union Carbide Nuclear Co., Inyo County, was in production throughout the year. The company produced and shipped both scheelite concentrate and ammonium paratungstate. In Madera County, New Idria Mining and Chemical Co. operated its Strawberry tungsten mine and mill for 5 months and stockpiled the concentrate produced. It planned to construct a chemical plant in Fresno, to process the ore and concentrate from the Strawberry mine. The plant was to use a new process developed by the Colorado School of Mines Research Foundation at Golden, Colo., and when the plant was completed, the company was expected to produce tungsten powder and a salable molybdenum product.

All other tungsten properties were idle except for assessment work.

Zinc.—The quantity of recoverable zinc produced decreased 35 percent. Virtually the entire output was derived from copper ore mined in Humboldt County and from lead and lead-zinc ores produced at Inyo County mines. Less than 1.5 tons of recoverable zinc was contained in all other lode materials combined.

Other Metals.—No chromite, manganese, uranium, or tin ores or concentrates were produced or shipped. Activity at the Pioneer manganese mine, Imperial County, consisted only of assessment work; that at the Santa Ana tin prospect in Trabuco Canyon, Orange County, of laboratory testing. Three cobalt-nickel prospects in Imperial County and one each in Del Norte and San Diego Counties were idle except for assessment and maintenance work. Assessment work was also the only activity at the Coyote Imp nickel property, Imperial County. A zircon placer prospect near Linden, Placer County, yielded a small quantity of zircon concentrate used for test purposes. The Major zirconium-hafnium claims near Mojave, Kern County, were inactive all year. Western Heavy Minerals, Inc., completed exploratory work for zirconium at prospects in Amador, Calaveras, Mariposa and Merced Counties and drilled along the lower Fresno River, Madera County, for about 7 miles. The Fresno operation proved uneconomic, but the company planned further work at the other properties.

American Potash & Chemical Corp. in conjunction with Laporte Titanium, Ltd., announced plans to build a titanium dioxide plant at Mojave, Kern County. The plant was to be operated on imported titanium minerals.

REVIEW BY COUNTIES

Alameda.—Producers of sand and gravel and stone supplied greater tonnages of aggregate for structural concrete and base material than in 1960. Much of the output was consumed in heavy-construction projects that included the MacArthur and Nimitz freeways, Webster St. estuary tube, Oakland International Airport, and the South Bay

Aqueduct. Over 7.2 million tons of sand and gravel was excavated by scraper and dragline from deposits on Alameda and Calaveras Creeks near Niles and Sunol, and from the streambed and alluvial fan of Arroyos Del Valle and Del Mocho near Pleasanton and Livermore. Major producers were Henry J. Kaiser Co., Pacific Cement & Aggregates, Inc., and Rhodes & Jamieson, Ltd. These companies each operated plants at two separate sand and gravel deposits. Stone quarries in the county yielded 2 million tons. Sandstone and miscellaneous stone from quarries in the San Leandro, Hayward, and Niles areas were used as base material. Basalt was obtained from the Leona quarry near Mountain Blvd., Oakland, and used for road base and fill. Holly Sugar Corp. produced lime for its own needs at Alvarado from purchased limestone. The company operated a shaft-type kiln, roaster, and continuous hydrator.

TABLE 24.—Value of mineral production in California, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Alameda	$19,720,317	$20,377,314	Sand and gravel, salt, stone, magnesium compounds, lime, bromine, clays.
Alpine	(1)	(1)	Sulfur ore, sand and gravel, stone, gold, silver.
Amador	1,656,175	1,725,090	Sand and gravel, coal (lignite), clays, stone, soapstone, gold, gem stones, silver.
Butte	[2] 4,950,912	6,094,813	Natural gas, sand and gravel, stone, gold, gem stones, silver.
Calaveras	13,583,617	15,193,899	Cement, stone, sand and gravel, clays, gold, silver, gem stones.
Colusa	[2] 2,720,645	3,261,387	Natural gas, sand and gravel, mercury, gem stones.
Contra Costa	[2] 3,654,852	5,610,570	Stone, natural gas, lime, sand and gravel, peat, clays.
Del Norte	248,870	383,930	Sand and gravel, stone, mercury.
El Dorado	1,991,850	4,555,312	Stone, lime, sand and gravel, soapstone, gem stones, gold, silver.
Fresno	[2] 88,175,465	86,491,519	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays, gold, asbestos, gem stones, mercury, diatomite, silver.
Glenn	[2] 8,574,535	8,242,776	Natural gas, sand and gravel, lime, stone.
Humboldt	[2] 2,566,159	2,922,790	Sand and gravel, copper, natural gas, stone, gold, zinc, silver, lead, gem stones.
Imperial	2,302,673	3,180,856	Gypsum, sand and gravel, lime, pumice, mica (scrap) stone, gem stones.
Inyo	10,956,725	8,214,684	Tungsten, sodium carbonate, talc, molybdenum, stone, boron minerals, copper, pumice, pumicite and volcanic cinder, sand and gravel, perlite, silver clays, lead, gold, sulfur ore, zinc, gem stones, mercury.
Kern	[2] 350,548,901	345,964,760	Petroleum, boron minerals, natural gas, cement natural gas liquids, stone, sand and gravel, gypsum,, sodium sulfate, clays, salt, pumice, carbon dioxide, gold, gem stones, silver.
Kings	[2] 12,735,138	12,992,480	Petroleum, natural gas, natural gas liquids, sand and gravel, gypsum, mercury.
Lake	681,830	572,737	Sand and gravel, pumice, pumicite and volcanic cinder, mercury, stone, sulfur ore, gem stones.
Lassen	367,885	788,928	Volcanic cinder, sand and gravel, stone, gem stones.
Los Angeles	[2] 236,753,357	241,067,665	Petroleum, sand and gravel, natural gas liquids, natural gas, stone, clays, iodine, cement, soapstone, gold, gem stones, silver.
Madera	[2] 1,308,294	1,488,264	Natural gas, stone, sand and gravel, pumice and pumicite, clays.
Marin	2,006,568	2,452,974	Stone, sand and gravel, clays, mercury, gem stones.
Mariposa	169,745	683,854	Stone, sand and gravel, gold, barite, silver, gem stones.
Mendocino	571,974	626,497	Sand and gravel, stone, gem stones.
Merced	1,201,528	1,365,709	Sand and gravel. gypsum, gold, stone, silver.
Modoc	683,649	406,099	Peat, sand and gravel, pumice and volcanic cinder, gem stones.
Mono	819,621	816,622	Pumice, clays, pyrophyllite, sand and gravel, lead, silver, zinc.
Monterey	[2] 28,594,705	29,992,230	Petroleum, lime, magnesium compounds, sand and gravel, stone, natural gas, feldspar, salt, gem stones.
Napa	839,321	2,485,846	Clays, stone, salt, asbestos, sand and gravel, diatomite, mercury, perlite.

See footnotes at end of table.

TABLE 24.—Value of mineral production in California, by counties—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Nevada	$484,466	$551,831	Sand and gravel, stone, gold, barite, copper, silver.
Orange	[2] 104,935,621	102,654,007	Petroleum, natural gas, natural gas liquids, sand and gravel, clays, stone, lime, salt, iodine, peat, gem stones.
Placer	1,187,301	1,639,158	Sand and gravel, clays, stone, gold, silver.
Plumas	262,806	1,121,885	Stone, sand and gravel, copper, gold, silver, zinc, gem stones, lead.
Riverside	36,692,145	41,281,366	Iron ore, cement, stone, sand and gravel, clays, gypsum, peat, wollastonite, petroleum, gem stones, barite.
Sacramento	[2] 19,784,897	24,680,566	Natural gas, sand and gravel, gold, clays, stone, platinum, silver.
San Benito	[2] 8,172,610	8,355,591	Cement, mercury, stone, petroleum, natural gas, sand and gravel, clays, gem stones.
San Bernardino	[2] 83,088,848	81,273,218	Cement, boron minerals, sodium carbonate, stone, sodium sulfate, potassium salts, sand and gravel, salt, talc and pyrophyllite, iron ore, clays, lithium, lime, calcium chloride, bromine, petroleum, rare earths, pumicite and volcanic cinder, barite, natural gas, gem stones, copper, fluorspar, gold, lead, silver, zinc.
San Diego	11,584,204	10,469,157	Sand and gravel, stone, salt, magnesium compounds, pyrophyllite, lime, clays, gem stones, gold, silver.
San Francisco	(1)	(1)	Stone, sand and gravel.
San Joaquin	[2] 5,850,959	8,406,301	Natural gas, sand and gravel, lime, clays, stone, gold.
San Luis Obispo	[2] 8,184,725	6,191,557	Petroleum, natural gas liquids, mercury, sand and gravel, stone, natural gas, gypsum, clays, gem stones.
San Mateo	[2] 11,682,657	11,924,911	Cement, stone, magnesium compounds, salt, petroleum, clays, sand and gravel, natural gas.
Santa Barbara	[2] 90,125,141	92,983,403	Petroleum, diatomite, natural gas, natural gas liquids, sand and gravel, stone, lime, mercury, gem stones.
Santa Clara	27,226,555	26,252,313	Cement, stone, sand and gravel, mercury, clays, magnesite, masonry, cement.
Santa Cruz	10,610,852	10,182,705	Cement, stone, sand and gravel, clays, potassium salts, gem stones.
Shasta	2,242,136	3,676,998	Sand and gravel, pyrites, iron ore, stone, volcanic cinder, gold, silver, gem stones.
Sierra	771,051	365,342	Gold, sand and gravel, stone, silver.
Siskiyou	1,508,718	908,806	Sand and gravel, pumice and volcanic cinder, stone, gold, gem stones, silver, copper.
Solano	[2] 11,989,353	11,467,944	Natural gas, stone, sand and gravel, petroleum, gem stones.
Sonoma	[2] 3,073,489	3,690,054	Sand and gravel, mercury, stone, natural gas, clays, gem stones.
Stanislaus	801,042	943,081	Sand and gravel, clays, stone, gold, silver.
Sutter	[2] 699,302	648,389	Natural gas, sand and gravel, stone, clays.
Tehama	[2] 1,357,931	1,459,195	Sand and gravel, natural gas, stone, volcanic cinder, gem stones.
Trinity	997,898	364,385	Sand and gravel. stone, gem stones, silver.
Tulare	[2] 4,153,242	9,065,125	Sand and gravel, natural gas, stone, barite, petroleum, clays, gem stones.
Tuolumne	1,632,817	1,167,840	Stone, lime, sand and gravel, clays, gold, silver.
Ventura	[2] 148,973,250	140,760,923	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays, gypsum.
Yolo	[2] 3,022,662	4,080,708	Sand and gravel, lime, natural gas, mercury.
Yuba	[2] 3,199,535	2,971,760	Gold, sand and gravel, clays, platinum, silver.
Undistributed [3]	[2] 1,983,476	3,250,876	
Total [4]	[2] 1,404,665,000	1,420,749,000	

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[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Revised figure.

[3] Includes gem stones, gold, lead, mercury, petroleum, and silver that cannot be assigned to specific counties and value indicated by footnote 1.

[4] Total adjusted to eliminate duplicating value of clays and stone used in manufacturing cement and lime.

Solar evaporating ponds covering several thousand acres yielded crude salt, which was washed and refined at four plants in the county. Leslie Salt Co. operated two plants at Newark and one plant at Mt. Eden. The company also sold crude salt to the Morton Salt Co. refinery in Newark. Oliver Bros. Salt Co. processed salt at a Mt. Eden plant. Salt works bitterns were piped to the nearby chemical plant of the FMC Corp. Mineral Products Division. The company used a gas-fired rotary kiln to produce lime from dolomite mined from a San Benito County quarry. The lime was used in extracting magnesia from the bitterns. Other plant products included synthetic gypsum and ethylene dibromide. FMC Corp., using phosphate rock and trona from company mines in Idaho and Wyoming, respectively, also operated a plant at this site to produce phosphoric acid and a variety of phosphate products. Fibreboard Paper Products Corp. purchased magnesium hydroxide and manufactured insulation in Emeryville. In Berkeley, Philadelphia Quartz Co. produced hydrous magnesium sulfate from purchased magnesite and brucite. Fibreboard also calcined crude gypsum from its Nevada mine for use in wallboard. Miscellaneous clay was dug from a deposit near Livermore by E. H. Metcalf Materials, from pits near Fremont by Interlocking Roof Tile Co. and Mission Clay Products Corp., and near Niles by Kraftile Co. These clays were sold or used for heavy clay products, floor and wall tile, stoneware, and terra cotta.

Open-hearth steel furnaces were operated by Judson Steel Corp. in Emeryville and by Pacific States Steel Corp. in Union City. The source for metal in both instances was iron and steel scrap. Installation of the proposed blast furnace for Pacific States Steel was delayed indefinitely. In Oakland, Chemical & Pigment Co. ground purchased metallic and nonmetallic minerals. C. K. Williams Co. produced natural and synthetic iron oxide pigments. Raw materials for the natural pigments were obtained from out-of-State sources.

Alpine.—Most of the sulfur ore mined in California during 1961 was obtained from the Leviathan mine near Markleeville. The Anaconda Company mined and trucked the crude mineral to its copper-leaching plant in Nevada where the ore was used in making sulfuric acid.

Government contractors produced the sand and gravel required to construct highways near Ebbetts Pass and Picketts. A portable preparation unit was operated by Nevada Lumber Co. on the west fork of the Carson River to produce aggregate for concrete. State road crews quarried decomposed granite used in road maintenance.

The only active metal mine was the Zaca near State Highway 89 southeast of Markleeville. Claude B. Lovestedt shipped silver ore from this property to the Selby smelter, Contra Costa County, where silver, gold, and lead were recovered. The ore also contained recoverable zinc.

Amador.—Silica sand from the Gladding, McBean & Co. clay-recovery plant near Ione was processed in the nearby sand plant of Owens-Illinois Glass Co. for glass manufacture and foundry use. Gladding, McBean began constructing a new and highly automated plant at Ione for processing additional tonnages of clay and sand. Fire clays recovered at the present plant, and those mined by Harbison-Walker Refractories Co. and Pacific Clay Products Co., were used in manufacturing heavy clay products and refractories. Pacific Clay Products Co. also produced miscellaneous clay. Also in the Ione area, Harley H. Kreth produced fill material for local use, and maintenance crews of the County road agency produced sand and gravel for their own use. South of Ione, Harbison-Walker Refractories Co. quarried quartzite from the Custer deposit for use in making silica brick. Dimension stone quarried by Sierra Madre Stone Co. near Volcano was used in constructing a State building in Modesto, Stanislaus County. Industrial Minerals & Chemical Co. at its O'Leary and Rancheria deposits near Sutter Creek mined soapstone, which was ground in its Florin plant, Sacramento County.

Near Ione, American Lignite Products Co., Inc., mined lignite, which it processed in its Buena Vista plant to recover montan wax and various byproducts.

A few tons of gold ore that contained recoverable gold and silver was produced at the Crescent mine near Pioneer. Stream gravels were worked by small-scale hand methods at various places, and a small quantity of placer gold was recovered.

Butte.—An average of 24 dry-gas wells produced throughout 1961, 3 more than in 1960; the natural-gas yield was about 12 percent more. The county was fifth among 21 producing counties, owing principally to output from the Wild Goose field. In December there were two new pool discoveries, the Capay and Forbes, both in the Llano Seco field by Sacramento Oil and Gas Co.

Construction at various Oroville Dam projects required substantially increased tonnages of sand, gravel, and stone. Producers of sand and gravel in the Chico, Gridley, and Oroville area prepared comparatively larger quantities of concrete (asphaltic and portland cement) aggregate than road-base material. The output was consumed in structures as well as in surfacing relocated highways and improving secondary roads. Several commercial producers operated portable crushing and batching plants near job sites to produce sand and gravel for concrete aggregate. The Oroville project contractors produced and prepared much of their own requirements for riprap and aggregate from quarries near the dam and streambed deposits at the Sly Creek and Miners Ranch construction sites.

Gold prospects near Big Butte Creek and Big Bear Mountain yielded a few tons of ore containing recoverable gold and silver. Placer gold and silver were recovered from bench gravels near Forbestown, ancient riverbed gravels at Butte Creek, and stream gravels at various places.

Calaveras.—Calaveras Cement Co. produced general-use, moderate-heat, high-early-strength, and plastic cements in its wet-process plant south of San Andreas. The raw materials for the plant were prepared in a five-kiln clinker section. Bulk and bag shipments were made by truck and rail to customers in California, Nevada, Oregon, and Colorado. Road construction near Vallecito, Angels Camp, and Dorrington, and building and paving activities at other places required increased output of sand and gravel, and stone. Government crews and contractors quarried granite and sandstone at various project sites. Calaveras Cement Co. quarried limestone near San Andreas for use in cement and as riprap. Roofing granules, decorative rock, and dimension building stone were produced at the Harley H. Kreth Pink Pit near Mokelumne Hill, the John C. Tarter Candy Rock quarry near Avery, and the Altaville Aggregates Peirano quarry. The Tarter operation, on Mill Creek Road, was new in 1961. Concrete aggregate and road-base material were produced by Neilson's Gravel Plant, Inc., near Mokelumne Hill, and Claude C. Wood

Co., near Camanche. Pacific Clay Products Co. operated a sand plant at Camanche to produce and prepare sand for glass manufacture. It mined fire clays for use in heavy clay products. Mission Clay Products Corp. produced fire clay and miscellaneous clay. Calaveras Cement Co. mined miscellaneous clay and shale for its own use. The Jefferson Lake Asbestos Co. prepared its asbestos deposit near Copperopolis for open-pit mining, completed extensive access-road building, and began constructing its processing plant.

Gold ores mined in previous years from the Carson Hill group of claims near Carson Hill and the Western Quartz mine south of Sheep Ranch were treated in 1961, and yielded small quantities of gold and silver. A few ounces of placer gold and silver were byproducts of a sand and gravel operation near Camanche; a homemade suction-dredge operation on the Stanislaus River at the north end of the Melones Reservoir recovered some placer gold. Stream gravels also were worked at various places to recover gold and silver.

Colusa.—Although there were 52 (average) producing dry-gas wells compared with 29 in 1960, natural-gas production rose only 15 percent. One new gas discovery, the College City field, was made in February by Honolulu Oil Corp. The initial well flowed 2,240,000 cubic feet from a producing level in the Forbes zone between 9,576 and 9,596 feet. The Grimes field was the most active gasfield with 16 completions. The Grimes West field had 11 completions, Kirk, 8; and Arbuckle, 6. Arbuckle was the county's most productive gasfield.

Greater tonnages of sand and gravel were produced by State highway contractors for road construction near Arbuckle, Grimes, and Williams, and by county road crews for secondary road maintenance. Cortina Rock Products in Colusa and Goforth Bros. in Williams obtained sand and gravel along Cortina and Sand Creeks and the Sacramento River for use in their concrete-batch plants.

A few flasks of mercury was furnaced from ore of the Elgin mine in the Sulphur Springs area. This mine had been idle since 1939.

Contra Costa.—Requirements of aggregate for constructing freeway approaches to the new Benicia-Martinez bridge and structural work at the Briones dam and reservoir project largely accounted for the increase in stone production over 1960. The stone came chiefly from quarries in the Clayton, Richmond, Pacheco, and Orinda areas. Blake Bros. Co. at Richmond and Henry J. Kaiser Co. and Pacific Cement & Aggregates, Inc., at Clayton were the major producers of stone. Sand pits near Cowell and Antioch and dredging in San Francisco Bay provided much of the paving sand used in commercial projects. Clays mined near Port Costa and Richmond, by Port Costa Brick Works and United Materials & Richmond Brick Co., Ltd., respectively, were used in manufacturing brick. At Antioch, Kaiser Gypsum Co. calcined gypsum from Mexico and expanded perlite from Nevada. The plant products were used in plaster and wallboard. Also in the Antioch area, Fibreboard Paper Products Co. recovered lime from its sulfate-pulp mill by using oil-fired rotary kilns.

Completion was made the first week in January on the significant dry-gas discovery of McCulloch Oil Corp. of California. The discovery well (McCulloch-Duarte No. 1) in the Domengine (Sub-Thrust) pool was considered one of the State's outstanding gas discoveries. The producing level was between 3,890 and 4,235 feet, initial production was 27,700,000 cubic feet a day from Eocene sands. Total dry-gas output in the county was nearly three times that in 1960; major production came from the Los Medanos field. Refineries at Avon and Rodeo produced petroleum coke and recovered hydrogen sulfide gas. Elemental sulfur was extracted from the gas. At the Selby lead smelter, stack gases were treated to produce liquid sulfur dioxide. Reed-sedge peat dredged in the San Joaquin River delta was mostly dried, shredded, and packaged for use as a soil-conditioning agent.

At Martinez, cement copper was reclaimed from solution residues in the Mountain Copper Co. chemical plant. The copper was shipped to the Tacoma, Wash., smelter for recovery of copper, gold, silver, and lead.

Del Norte.—The demand for sand and gravel and stone was less than in 1960, particularly for road-construction. Producers of sand and gravel worked streambed and gravel-bar deposits on the Smith and Klamath Rivers. Several lumber companies produced their own requirements of these materials for maintaining access roads. County road crews obtained riprap and roadstone from the rocky bluffs at Endert's beach south of Crescent City.

Ore from the Webb mine in the Patricks Creek area was retorted to produce a small quantity of mercury. The property had been idle since 1956.

El Dorado.—More sand and gravel and crushed stone were produced and used in the Upper American River Project than in 1960 for constructing reservoirs, dams, conduits, powerhouses, and roads near Cool, Georgetown, Placerville, and Shingle Springs. Contractors for the Sacramento Municipal Utility District quarried and prepared substantial quantities of granite for riprap, filter use, and concrete aggregate. Limestone, quarried near Auburn, Cool, Diamond Springs, and Shingle Springs, was used as flux, and concrete aggregate in manufacturing lime, whiting, glass, in refining sugar, and for various uses in agriculture and industry. The Auburn and Shingle Springs deposits were worked by underground methods; the others were open quarries. Placerville Slate Products Co. mined slate underground near Chili Bar and prepared the material for use as granules and flour. Sierra Placerite Corp. produced dimension building stone at its quarry southeast of Placerville. Chris Henningsen & Sons supplied sand and gravel for concrete and road-base material from mill tailing at Lotus on the American River. Lagrange Construction Co. operated a portable sand and gravel preparation plant on Angora Creek near Tahoe Village to supply these materials for surfacing asphaltic highways and as road-base material. At Diamond Springs, the Diamond Springs Lime Co. used an oil-fired rotary kiln and a continuous hydrator to provide quicklime and hydrated lime for agriculture, construction, and various chemical and industrial uses. Pacific Mineral Products Co. mined soapstone from its Shrub property and shipped the crude mineral to the San Francisco Bay area, where it was ground for use in insecticides, ceramics, joint (wallboard) compound, and rubber products.

Cleanup operations at the Alhambra lode gold mine near Spanish Flat yielded a few ounces of gold. Stream gravels at various places were worked by small-scale hand methods to recover placer gold and silver.

Fresno.—Production of crude oil declined 3 percent; wet-gas output was virtually unchanged from 1960. An average of 2,701 oil wells was productive compared with 2,669 in 1960. Seven exploratory wells were drilled but none resulted in the discovery of either oil or gas. A total of 27 dry holes was drilled during the year; 5 of these were suspended; the remainder were abandoned. Most activity appeared to be centered in the Helm area where four well completions were made. Only one dry-gas well was productive, the same number as in 1960, but output increased 60 percent. The well is near the county line in the Gill Ranch fields. Wet gas was processed at four plants; two plants operated by Socony Mobil Oil Co., Inc. at Avenal and Burrel; and one each, by Standard Oil Co. and Union Oil Co. at Coalinga. Production from these plants increased 3 percent in both natural gasoline and cycle products, and LP gases.

Production of sand and gravel increased; it came principally from pits in the Coalinga, Fresno, Friant, Pinedale, and Sanger areas. Much of the output was used in building and paving projects in Fresno, at new real-estate subdivisions in unincorporated areas, and for State and county road construction. The major sand and gravel producers operated preparation plants along Los Gatos Creek, and the San Joaquin and Kings Rivers. The tonnage of granite rock quarried by Government contractors, and used as road base material represented virtually the entire increase in stone output. Superior Academy Granite Co. quarried dimension stone near Academy for monuments. Craycroft Brick Co. from deposits near Fresno mined miscellaneous clay, which was used to manufacture heavy clay products. Construction of a processing plant at the Coalinga Asbestos Co., Inc., property northwest of Coalinga neared completion. Union Carbide Nuclear Co. and Hidden Splendor Mining Co. continued exploration and development for asbestos, and Todd Industries, Inc. did metallurgical testing at its asbestos plant. Fresno Rock Co. mined diatomite from an open pit near Mendota for its own use. The South Dome pumice operation east of Friant was idle. Fresno Perlite Corp. expanded crude perlite purchased from Colorado and Nevada producers in its Fresno plant for use in building plaster and oil well-drilling slurries.

Except for one small-scale placer in the Friant area, all gold and silver were byproducts from sand and gravel plants along the San Joaquin River. Old furnace brick at the Archer mine northwest of Coalinga were furnaced to recover mercury.

Glenn.—Despite an 8-percent decline in output of natural gas, the county ranked third after Sacramento and Solano Counties in total dry-gas production. The Willows-Beehive Bend field was the major productive source; output came from an average of 88 wells, 13 more than in 1960. Drilling activity also centered about this field, where five well completions were made in 1961.

Sand and gravel production declined, owing principally to inactivity at the Wyo gravel operation. Orland Sand and Gravel Co.

prepared sand and gravel for use in the Black Butte Dam tunnel project. The company used a dragline to excavate the streambed of Stony Creek and hauled the materials to its Orland processing plant. Mack Rock & Sand Corp. also obtained aggregate from streambed deposits. Willows Ready Mix Concrete Sand & Gravel Co. worked the flood plain of Walker Creek for sand and gravel used in its batch plant. County road crews produced much of their gravel requirements from deposits in the Willows area. Holly Sugar Corp. purchased limestone to produce lime which was used in recovering sugar from sugar-beet molasses at its Hamilton City plant.

Humboldt.—Paving projects that included freeway construction north of Fortuna and south of Field Landing and repairs to jetties at Eureka required increased output of sand and gravel. Much of the production came from streambed deposits of the Eel, Mad, and Van Duzen Rivers, and was prepared for use at plants in Arcata and Fortuna. Government crews and contractors quarried sandstone and miscellaneous stone for riprap. A hillside quarry east of Eureka was the source for riprap in 6- to 25-ton sizes used in protecting the jetties in Humboldt Bay.

The Table Bluff gasfield (discovered in 1960 near Loleta) was the only source for natural gas in the county. Output came from an average of nine wells, two more than in 1960. These two additional wells were completed in 1961 and contributed to a production that was nearly 50 percent greater.

The Copper Bluff lode mine near Hoopa was the only active metal mine in the county. Celtor Chemical Corp. processed copper ore from Copper Bluff in its mill and shipped the concentrate to smelters in California, Idaho, Montana, and Washington. This mine was the largest single source of recoverable copper, gold, silver, and zinc in the State. The mill concentrate also contained important quantities of recoverable lead.

Imperial.—United States Gypsum Co. mined crude gypsum at its Fish Creek Mountains deposit and processed the mineral at its gypsum products plant in Plaster City. During the year, the company added a rotary drill to its mining equipment and added a dust collector to its crushing system.

Sand and gravel production increased above the 1960 figure, owing primarily to greater building and paving activity at El Centro and Brawley, and at a new housing development on the west shore of the Salton Sea. Sources for these materials, used as road base and concrete aggregate, were ancient beach deposits near Brawley, Holtville, and Westmoreland, and alluvial fan and dry-wash deposits in the Winterhaven, Glamis, Salton City, and Coyote Wells areas. Light-colored basalt from the Navajo quarry in the Painted Gorge area near Coyote Wells was used as roofing granules. Granite quarried near Plaster City, Calexico, and Winterhaven was used in driveways, as road base, and for riprap in irrigation and levee systems.

Holly Sugar Corp. purchased limestone to produce lime for use at its Carlton beet-sugar-processing plant. Aricalite Builders Supply Co. mined pumice near Calipatria and used the material as lightweight concrete aggregate. C. O. Fiedler, Inc., mined crude mica (sericite schist) near Ogilby and dry-ground it for use in roofing-material manufacture.

Inyo.—The Pine Creek tungsten operation of Union Carbide Nuclear Co. was active throughout the year. The entire marketed production of tungsten concentrate and ammonium paratungstate and the entire output of molybdenum concentrate in the State were credited to Pine Creek. The Pine Creek mine was one of two principal sources in California for copper and silver. Molybdenum and copper concentrates were byproducts in milling tungsten ore. Eight lead and lead-zinc mines contributed to the recoverable lead and zinc output; however, lead ores from the Shoshone and Hope groups together with lead and lead-zinc ores mined in 1960 at the Defense and Santa Rosa mines added appreciably to the total lead, zinc, and silver recovered during the year.

Pittsburgh Plate Glass Co. produced anhydrous sodium carbonate (soda ash) and sodium sesquicarbonate from Owens Lake brines at its plant in Bartlett. United States Borax & Chemical Corp. mined borate minerals underground in Corkscrew Canyon (colemanite) and near Shoshone (ulexite) and processed these minerals in its Kern County refinery. The Warm Springs property of Grantham mines was the major talc producer; in all 18 talc mines were active. Callahan Industrial Minerals Co. acquired the White Eagle talc mine from Huntley Industrial Minerals Co. late in the year. Sand and gravel was prepared in plants near Bishop and Lone Pine and at a highway project near Little Lake. Maintenance crews for the Death Valley National Monument, Inyo National Forest, and the County road agency produced the materials for their own use. West End Chemical Co. quarried limestone north of Searles Lake and processed it to produce carbon dioxide and lime in its plant on Searles Lake, San Bernardino County. Marble from an underground quarry near Independence was prepared for use as building stone, roofing granules, and terrazzo. Quarries near Lone Pine and Big Pine produced quartzite used as building stone and in manufacturing silica brick. Dimension building stone was the principal product at quarries in the Ballarat, Olancha, and Death Valley Junction areas. Three pits, two near Coso Junction and one a few miles north of Bishop, yielded pumice, pumicite, and volcanic cinder, used chiefly as lightweight-concrete aggregate. Crude perlite from the Fish Springs quarry south of Big Pine was expanded in plants outside the county. Fuller's earth, mined from the Olancha and Little Joe pits southeast of Owens Lake by Sierra Talc Co. and David Jones, respectively, was prepared for filler, filter aid, and absorbent uses. Kennedy Minerals Co. worked the Ibex bentonite deposit southwest of Tecopa and used the mineral as a component in enamel. L. R. Moretti mined bentonite at the Side Hill property and sold it for use in cosmetics and pharmaceuticals, for pelletizing, and for sealing reservoirs. Inyo Soil Sulphur Co. produced sulfur ore at the Crater Sulphur mine and prepared it for agricultural use.

Cleanup operations at the Nancy mine near Tecopa recovered a relatively small quantity of mercury. White Caps Gold Mining Co. did exploration at the Sorensen beryllium prospect near Lone Pine.

Kern.—Despite a decline of 1,618,581 barrels in crude-oil production, Kern County led in petroleum output. Exploratory drilling resulted in six new oil discoveries, two new fields, and four new pools.

The discovery well of the Kernsumner field was brought in on June 3 by Signal Oil and Gas Co.; a second well was brought in 10 days later. Initial flow from the discovery well was 61 barrels a day from 3 perforations below 10,500 feet. Phillips Petroleum Co. made the second field discovery (Valpredo) on November 11. Another well was brought in on November 30. Initial production (pump) was 88 barrels a day from the discovery well at the 6,691- to 6,735-foot level. The oil-pool discoveries were Universal Consolidated Oil Co. in the Gosford East field on March 18; The Superior Oil Co. in the Rio Bravo field on July 16; Standard Oil Co. of California in the Ten Section field on July 21; and Richfield Oil Corp. in the Wheeler Ridge field on October 7.

Despite the decline in crude petroleum production, natural-gas output from oil zones increased 4 percent. Reports from wet-gas-processing plants indicated that natural gasoline and cycle products declined 4 percent and LP gas increased 1 percent. Tidewater Oil Co. acquired a natural-gasoline plant in Taft from Honolulu Oil Corp. in October; this plant yielded the entire output of marketed carbon dioxide in the State and reported a 23-percent increase over 1960 production. The dry-gas yield rose 44 percent, and a new gasfield (Semitropic Northwest) was discovered in 1961. Texaco, Inc., completed the discovery well on March 14. In the initial test, the well flowed 1,330,000 cubic feet a day through a 16/64 bean, producing between 2,735 and 2,737 feet. Two other intervals were productive: A 26-foot interval between 6,154 and 6,180 feet and a 78-foot interval between 6,255 and 6,333 feet. Continental Carbon Co. placed a new carbon black plant on stream in August, and United Carbon Co. was constructing a similar plant in Mojave at yearend.

United States Borax & Chemical Co., the leading domestic producer of borate minerals and boron compounds, mined crude borates from an open pit and processed them at an adjacent refinery near Boron. Borate minerals from the company underground mines in Inyo County were processed at the same plant. Partly refined minerals were shipped to the company refinery in Los Angeles County for further processing and product manufacturing. The Boron plant also yielded byproduct sodium sulfate. A small tonnage of crude borates was sold to chemical companies, principally in the Los Angeles area. Appreciable quantities of borates were purchased by the General Services Administration for use as a fire retardant by the U.S. Forest Service. Western Salt Co. harvested solar-evaporated salt from Koehn dry lake and processed it in its Saltdale plant. The final product was shipped to customers in Los Angeles County.

California Portland Cement Co. and Monolith Portland Cement Co. operated five-kiln plants at Mojave (dry process) and Monolith (wet process), respectively. Bulk and bag shipments were made by truck and rail to consumers in Arizona, California, and Nevada. Early completion of several freeway projects under construction in 1960 made the output of paving sand and gravel decline in 1961. However, larger tonnages of concrete aggregate were required for building construction, notably in the Delano and Wasco areas. The principal commercial aggregate preparation plants were near the Kern River in the Bakersfield area. Other commercial plants were in Taft and Ridgecrest. Stone production increased considerably as larger tonnages of limestone were quarried for use in making cement. Other quarries near Mojave and Monolith, and near Tehachapi, Maricopa, and Rosamond were major sources of building stone, roofing granules, and decorative aggregate. Nearly 727,000 tons of agricultural gypsum was mined in the Lost Hills, Maricopa, and Taft areas. H. M. Holloway, Inc., the principal gypsum producer in the State, operated a crushing and screening plant at Lost Hills. Holloway completed more than 45,000 feet of exploratory drilling during the year. Agricultural gypsum also was mined by C. L. Fannin and Superior Gypsum Co. (Lost Hills), Tembler Gypsum Co. and Sunset Agricultural Minerals (Taft), and Landson Mining Co. (Maricopa). Clays produced near Tehachapi were used in making cement at Monolith. American Mineral Co. mined miscellaneous clay from the White Rock deposit near Mojave for use in pottery, stoneware, and rubber. Miscellaneous clay was produced near McKittrick by Excel Minerals Co. for use as absorbents and by McKittrick Mud Co. for use in rotary-drilling muds. Clays used in compounding drilling muds also were produced by Macco Corp. near Rosamond, and by Mojave Corp. near Boron. Pumice was obtained from a pit south of Inyokern by Calsilco Corp. and was prepared for use as an oil and grease absorbent.

The Yellow Aster and Big Dyke lode gold mines in the Randsburg area and old tailings from the Butte Lode property yielded most of the recoverable gold; the Wegman group and Elephant mine near Mojave contributed to the total output. Silver ores from the Silver Vein prospect south of Mojave and the Big 4 mine near Sageland were the principal sources of recoverable silver. Cleanup operations at the Middle Butte placer claims and stream gravels in the Green Mountain area yielded a few ounces of placer gold. A 50-ton-a-day retort was installed at the Durnal mine of Sierra Quicksilver Corp. near Keene, but no mercury was produced.

Kings.—Crude petroleum production declined 9 percent from that of 1960. No new oil discoveries were made during 1961; however, two well completions were made in the Kettleman (North Dome) field and three were made in the Pyramid Hill field. Five exploratory wells were drilled for a total of 33,256 feet; all wells were dry holes. Despite the decrease in oil output, natural-gas production from oil zones was more than double that in 1960. Caminol Co. processed crude petroleum in a cracking and skimming plant at Hanford. Standard Oil Co. of California operated a wet-gas-processing facility near Avenal that combined four previously independently operated plants. Output of natural gasoline and cycle products from this facility declined 9 percent; output of LP gas declined 24 percent. Dry-gas production, limited to the Dudley Ridge (Tulare Lake) field and part of the Trico field, decreased 10 percent. Only one gas-well completion (at Dudley Ridge) was made in 1961.

Sand and gravel was produced only for fill by maintenance crews of the county road agency. Sand and gravel and stone for building and paving were obtained from pits and quarries in neighboring counties, chiefly Fresno and Tulare. McPhail Gypsum Co. mined gypsum for agricultural use from a deposit southeast of Avenal.

Ores from the Little King (Fredanna) mine near Parkfield were furnaced to recover a significant quantity of mercury. Cinnabar ore produced at the nearby Dawson property also was retorted to yield mercury.

Lake.—Paving of State Highway 53 south of Lower Lake and maintenance of Lake County roads required substantial quantities of sand and gravel. Output of building sand and gravel increased notably over that of 1960 in the Lakeport, Kelseyville, and Clear Lake Highlands area. Commercial producers operated stationary and portable preparation plants near streambed deposits at Clear Lake and Middletown. Miscellaneous stone was quarried by Government contractors for use as riprap and fill in protecting flood-control embankments. Volcanic ash and cinder were mined near Clear Lake for use as lightweight aggregate, roofing granules, in landscaping, and in surfacing roads.

Ore from the Abbott underground mercury mine was furnaced. Abbott Mines, Inc., acquired control of the property from COG Minerals Corp. on May 1 and operated the mine and plant after that date. Sulfur ore was mined at the Sulphur Bank mines near Clear Lake by Wolf Creek Mining Co., and on the S Bar S ranch east of Kelseyville by American Mineral Resource Development Co. for soil additive.

Lassen.—Large tonnages of volcanic cinder were produced for use in road construction and maintenance by crews and contractors for the California Division of Highways and by crews employed by the U.S. Forest Service. Harms Bros. was a major contractor for the road construction and repair. Mt. Lassen Cinder Co. mined cinder from a Poison Lake deposit and prepared the material for concrete aggregate.

Construction of roads administered by the Federal Bureau of Public Roads and the California Division of Highways required substantially larger tonnages of sand and gravel than in 1960. In most instances the materials were produced at the project site by contractors. Commercial sand and gravel requirements were supplied principally by producers in neighboring Plumas County. Sierra Ordnance Depot crews quarried granite used in road maintenance and used gravel purchased from a Reno, Nev., producer as railroad ballast.

Los Angeles.—Production of crude oil was 792,856 barrels, only 1 percent more than in 1960. One new discovery was made, a new pool found by Union Oil Co. of California in the Las Cienegas field on September 9. The well was producible but was shut-in and had not been tested at yearend. Development activity was high at the Wilmington field where 40 well completions, compared with 31 in 1960, were reported. Fourteen of these wells were in the Harbor area. At Whittier field 27 new wells, 22 more than in 1960, were completed in the Central area. At Long Beach field, new completions totaled 15, 11 more than in 1960, all in the Old area. Secondary recovery projects were underway in the Domingues and Long Beach (Airport area) fields, the North Block of Seal Beach field, the Central area of Whittier field, and the Ranger pool of the Wilmington field. About 62 percent of California's cracking and reforming capacity was in Los Angeles County. Nearly 45 percent more wet gas was produced and processed than in 1960, resulting in a 26-percent increase in LP-gas output. However, natural-gasoline and cycle product output decreased 10 percent. The number of active natural gasoline plants in the county was unchanged at 19, out of a total of 69 in the State. Dry-gas production rose 6 percent; the increase was credited to older wells in established fields as no new well completions were reported.

Sand and gravel output was 6.5 million tons more than in 1960 because of increased building activity and construction of freeway interchanges and extensions. Structural uses rose 35 percent, and road construction required 38 percent more. Eleven commercial sand and gravel plants near Arcadia, Azusa, Irwindale, Pasadena, and Sun Valley each produced more than 1 million tons for a combined total of nearly 17 million tons. There were 19 other active commercial plants in the county, of which 6 were in the 500,000- to 1-million-ton class. Government crews and contractors produced and prepared sand and gravel for their own use. Molding, blast, and engine sands were produced at plants near El Segundo, Huntington Park, and Torrance. Over 600,000 tons of decomposed granite was quarried for riprap and as base material in construction projects. Dimension stone produced at quarries near Palos Verdes and Saugus was used in building construction, and for flagging and rubble. Connolly-Pacific Co. quarried miscellaneous stone (diorite and conglomerate) on Catalina Island east of Avalon to supply breakwater and revetment stone for the new Playa Del Marina and for the harbors at San Pedro, Long Beach, and Ventura. The Empire quarry on Catalina Island was idle but was expected to again be in full operation early in 1962.

California Portland Cement Co. purchased the cement mill of Blue Diamond Co. in Los Angeles on January 1, but Blue Diamond operated the mill until January 15 to use up clinker stocks. Crude gypsum from out-of-State sources was consumed in lath, plaster, and wallboard plants. Fibreboard Paper Product Corp. used gypsum from a company mine in Nevada at its South Gate plant, and Kaiser Gypsum Co., Inc., using company ore carriers, brought in crude gypsum from Mexico for its Long Beach plant. Seven producers mined miscellaneous clay for making heavy clay products. Most of the output was obtained from four deposits: Near Torrance by Higgins Brick & Tile Co., in Los Angeles by Davidson Brick Co., at Compton by Atkinson Brick Co., and near Van Nuys by Valley Brick & Supply Co. Soapstone from the Katz deposit in Sierra Pelona valley was ground for use in ceramics and as a carrier in insecticides and fungicides. Seven companies expanded crude perlite from mines in California, Colorado, Nevada, and New Mexico. Six plants ground talc, soapstone, and pyrophyllite received from California and Nevada producers. California Zonolite Co. exfoliated crude vermiculite from its Montana property and sold the product for plaster aggregate, thermal and acoustical insulation, and soil additive. Calada Materials Co. and Oil Base, Inc., ground crude barite obtained from company mines in California and Nevada, at plants in Harbor City and Compton, respectively. Crude mica received from South Dakota and imported from India was dry-ground at a plant in Los

Nietos by Sunshine Mica Co. The plant product was sold to manufacturers of paint and roofing materials.

Dow Chemical Co. pumped waste oil-well brines from wells in the Los Angeles basin to its iodine-extraction plant in Orange County. In Wilmington, United States Borax & Chemical Co. operated a refinery on crude and partly refined borates received from its Kern County mine and plant. Some byproduct sodium sulfate was recovered in the processing.

Small quantities of placer gold and silver were byproducts of a sand and gravel washing plant operated by Livingston Rock & Gravel Co. in the Big Tujunga Wash area. Stream gravels were panned in the San Gabriel River channel to recover a few ounces of gold. Several tons of gold ore mined at the High Grade lode prospect near Acton contained recoverable gold and silver. Electric furnaces were operated to produce steel ingots from ferrous scrap by Bethlehem Pacific Coast Steel Corp. at Vernon, by National Supply Co. at Torrance, and by Southwest Steel Rolling Mills at Los Angeles. Another plant at Torrance, operated by Columbia-Geneva Steel Division, United States Steel Corp., used open-hearth furnaces. All four companies produced finished-steel products.

Madera.—Dry-gas production, from three gasfields, was 10 percent more than in 1960. The average number of producing wells was unchanged at 12. Most of the production came from the Gill Ranch field.

Road construction and extension of irrigation systems required substantially larger tonnages of sand and gravel than in 1960. C & T Rock Co. in Madera, Industrial Asphalt Co. in Pinedale, and Government crews and contractors worked streambed and flood-plain deposits of the San Joaquin River for sand and gravel. Granite was quarried for county and State road agencies for use as riprap and road base. Raymond Granite Co. used a wire saw to produce dimension, architectural, and monumental stone. Dimension building stone was quarried by Sierra Lava Stone near Raymond and by Fresno Rock Co. near O'Neal. California Industrial Minerals Co. and Elmer Erickson obtained pumice and volcanic ash from deposits south of Belleview and prepared the materials for use as lightweight aggregate and as a carrier in pesticides. Hans Sumpf Co. obtained clayey soil from a pit near Madera and used the material to make adobe brick.

The Strawberry tungsten mine and mill near Bass Lake were active part of the year. New Idria Mining & Chemical Co., owner of the property, stockpiled the ore and concentrate pending construction of a processing plant at Fresno.

Marin.—United Sand & Gravel Co. new "hopper" (self-contained unit without a barge) dredge in San Francisco Bay supplied fill material for road construction. Output from this operation was the principal reason for sand and gravel production exceeding that in 1960. Stationary and portable preparation plants near Corte Madera, Black Point, and Point Reyes Station supplied local requirements for concrete aggregate and road-base material. Basalt and sandstone were quarried near San Rafael and Novato by Basalt Rock Co., and near Greenbrae by Hutchinson Co. More than one-half the sandstone production from the McNear quarry near San Rafael was barged to the Sacramento River levee system and used as riprap. Shale from the nearby McNear pit was consumed in heavy clay products or expanded for lightweight aggregate. A plant at Sausalito expanded crude perlite, mined in Inyo County, and sold the product for a wide variety of uses.

The Edwards and Gambonini mercury mines, near Marshall, were both active. Ores from these mines were retorted to recover substantial quantities of mercury.

Mariposa.—Granite quarried and stockpiled by a contractor in 1960 was used in 1961 for improving roads in Yosemite National Park as part of the Mission 66 conservation and development program. State and county road crews and contractors also quarried granite for maintenance and construction of roads near Coulterville and Mariposa. Slate from the Agua Fria and Mt. Bullion quarries near Mariposa was used for roofing, flagging, patios, and walls. Rough and decorative building and masonry stone was produced at Haigh's quarry, 5 miles north of Coulterville. Quarrying operations at the Old Mary Harrison mine in the same area had been discontinued at the end of 1960. Concrete aggregate and road-base materials were produced by Henley Sand and Gravel near Buck Meadows and by Mariposa Sand and Gravel Co. near Mariposa and El Portal. Mariposa Sand and Gravel Co. worked both the Mariposa Creek tailings and the streambed deposits on the Merced River to obtain sand and gravel. A small tonnage of crude barite was mined at the Egenhoff property in the Granite Creek area and shipped to a grinder in Los Angeles County.

Six lode-gold mines were active near Coulterville and Mariposa during the year; ore from the Red Banks mine yielded most of the recoverable gold and silver. The Mariposa Sand & Gravel Co. washing plant recovered some byproduct placer gold and silver. Stream gravels were worked by small-scale hand methods, including a small homemade suction dredge, to recover a few ounces of gold.

Mendocino.—Operators in the Ukiah, Manchester, Fort Bragg, Willits, and Covelo areas worked streambed deposits to produce building and paving sand and gravel. The output was used mostly in constructing and resurfacing roads near Ukiah and Hopland. At yearend the assets of Ukiah Gravel & Cement Co., Inc., one of the oldest established sand and gravel firms in the county, were sold to a Los Angeles buyer. The new owner sold the equipment and leased the property, which consisted of 100 acres of land along the Russian River near Ukiah. Sandstone and miscellaneous-stone quarries were operated by Government crews and contractors to obtain riprap and road-base materials.

Merced.—Sand and gravel was produced and prepared at plants near Cressey, Le Grand, Los Banos, Merced, Snelling, and Turlock. Floating suction pumps and draglines were used on the Merced River to excavate sand and gravel from the streambed and adjacent flood plain. County crews operated a plant near Bear Creek and prepared hot-mix and road-base materials used in maintaining and repairing county roads. A Fresno paving contractor set up a portable screening plant at Maricopa Creek near Le Grand during the year. A small tonnage of riprap was quarried near Los Banos for use by the Federal Bureau of Reclamation. The Little Panoche gypsum deposit south of Los Banos was mined by Agricultural Minerals & Fertilizer Co. for agricultural gypsite consumed locally.

Byproduct gold and silver were recovered at the sand and gravel preparation plant of River Rock Co. near Snelling.

Modoc.—Peat moss was mined from a bog in Jess Valley near Likely by Jeffery & Associates using a dragline excavator, clamshell, bulldozer, and bucket loader. The tonnage mined and sold was about 10 percent greater than in 1960. Most of the output was packaged for use as a soil-improvement agent. Shipments were made to customers in Washington, Oregon, Nevada, Utah, Arizona, New Mexico, and Texas, but a high percentage of the total sold went to consumers in California.

Sand and gravel production was limited primarily to building and paving requirements in the Alturas and Likely areas. Much of the production was used in the latter area to improve U.S. Highway 395. Moyer Gravel Co. worked an old streambed terrace along the north fork of the Pit River near Alturas to obtain concrete aggregate and road-base material. Pumice was mined near Tionesta by H. P. Free who prepared and marketed the material for lightweight aggregate. A small tonnage of volcanic cinder was mined on National Forest land by Federal employees for use in maintaining U.S. Forest Service roads.

Mono.—Pumice deposits near Chalfont, Benton, and Lee Vining yielded material that was prepared and sold for use in acoustical plaster, as lightweight aggregate, and as an abrasive (scouring blocks). Some of the pumice was sold as decorative rock and roofing granules.

Huntley Industrial Minerals, Inc., and Callahan Industrial Minerals Co. mined kaolin, concurrently, from the Little Antelope deposit near Casa Diablo and prepared the mineral for use in whiteware, floor and wall tile, and refractories. They also worked the Pacific pyrophyllite mine near White Mountain in the same manner and ground the mineral in the Laws plant for use in wallboard, paint, and ceramics. The Callahan company acquired the Huntley mining properties and plants late in 1961.

Sand and gravel was produced by State and County crews and contractors, and used in asphaltic concrete for repairing and maintaining roads near Bridgeport and Topaz. Lead ore mined from the Antimony claims in the West Walker River area yielded recoverable quantities of lead, silver, and zinc.

Monterey.—Crude oil production was 2 percent more than in 1960. The output came from an average of 764 wells in 3 active fields—The San Ardo, King City, and Monroe Swell. This was an average of 43 more wells than in 1960. There were no discoveries, but 45 new wells were completed in the San Ardo field with an initial production average of 112 barrels a day, and 5 new wells, averaging 82 barrels a day initially, were completed in the King City field. Eleven exploratory wells were drilled, but all were unsuccessful. The natural-gas output, all from oil zones, rose nearly 28 percent. The entire output of petroleum and wet gas was processed in plants outside the county.

Kaiser Aluminum & Chemical Corp., produced lime in its Natividad plant, from limestone and dolomite obtained from its nearby quarries;

it used three gas-fired rotary kilns and a continuous hydrator. Although the company produced and sold lime for construction, agricultural, and industrial uses, most of the dolomitic lime produced was consumed in the producer's sea-water-processing plant at Moss Landing to recover magnesium hydroxide. The magnesium hydroxide was calcined and the resulting various grades of magnesia together with chromite from the Philippine Islands were consumed in manufacturing refractories. The Monterey Bay Salt Works harvested crude salt from approximately 400 acres of solar evaporating ponds near Moss Landing. At Spreckels, Spreckels Sugar Co. produced lime from purchased limestone for use in its sugar-beet refinery.

Sand and gravel production decreased to 588,000 tons, as major road construction projects were completed. Much of the output was used in highways near Greenfield, Salinas, Lucia, and Monterey, and for building construction at Fort Ord. Industrial sands prepared for glass, molding, filler, foundry, and other uses were obtained from dune deposits in the Monterey Bay area. Owens-Illinois Glass Co. and Del Monte Properties Co. were major producers of glass sand. Del Monte operated a flotation plant and produced both feldspar and silica concentrates. The ground and unground sands and plant products were blended to supply specialty products used in making pottery, clay pipe, sanitary ware, and ceramic insulators, and sold for foundry and filter uses. Larger tonnages of dolomite were quarried in 1961 at the Kaiser Natividad operation for sale as a fertilizer filler, and for roofing and landscaping as well as for use in Kaiser's Moss Landing magnesia plant. Dimension building (miscellaneous) stone was quarried near Carmel and San Ardo, and decomposed-granite quarries near Pebble Beach, Monterey, and Salinas were major sources for road-base material.

Napa.—Basalt Rock Co. mined shale at its Oakville deposit and expanded the material for use as lightweight aggregate. It also prepared diatomaceous silica, mined in previous years, in its Napa plant for use in pozzolanic cement. The nearby Pedrotti stone quarry was worked for riprap and base material used in road construction. County road crews quarried miscellaneous stone at the Parker Hill property east of Yountville and used the material in maintaining roads. Sand and gravel was produced and prepared near Angwin, St. Helena, Rutherford, and Napa by commercial producers, and by Government crews and contractors for building and paving. Perlite Aggregates, Inc., expanded crude perlite from the Alvo quarry in its plant near St. Helena.

Leslie Salt Co. harvested salt on San Pablo Bay for the first time in 1961 from solar evaporating ponds that had been constructed several years earlier. Asbestos Bonding Co. increased production of short-fiber chrysotile asbestos at its Phoenix mine near Napa. It was the leading producer of asbestos in the State.

Six operators retorted dump material from the Oat Hill mine to produce mercury or worked the James creek gravels to recover the metal that had washed into the creek bottom from the old Oat Hill operation.

Nevada.—Road-construction projects, chiefly the sections of U.S. Highway 40 extending into the county, required greater tonnages of sand and gravel than in 1960. This production was principally by Government contractors. Clements Rock Products, Inc., operated a bucket dredge and a dragline excavator near Truckee to produce aggregate for portland and bituminous concrete. Hanson Bros. used a dragline excavator to obtain sand and gravel from the Bear River for use in its Grass Valley batch plant. The Bear River channel also was the source of cobbles crushed for use as an abrasive in a household cleanser. Stone was quarried by State highway and Federal Bureau of Reclamation contractors for use as riprap and road base. The riprap was used in constructing flood-control dams near Truckee.

Most of the lode gold and silver output came from cleanup operations at the Brunswick-Idaho Maryland and Willow Valley mines and the treatment of old tailings and dump material at the Empire Star property, all in the Grass Valley-Nevada City area. Some gold ore was mined at the Red Ledge mine near Washington, and copper ore from the Conrad mine near English Mountain contained recoverable copper, gold, and silver. Deer Creek Enterprises washed ancient riverbed gravels in the Mooney Flat area, and streambed gravels were worked by a number of individuals in the Washington, North Columbia, Grass Valley, French Corral, and Graniteville areas to recover relatively small quantities of placer gold and silver.

Industrial Minerals & Chemical Co. at the Democrat Extension property mined barite which was ground in its plant in Sacramento County.

Orange.—Crude-petroleum production declined about 2 percent from that of 1960 and came from an average of three less producing wells. Gulf Oil Corp. of California discovered a new pool in the Yorba Linda field; the well completion was made in April. Initial production (pump) was 126 barrels a day from 3 perforations; the combined producing interval was 47 feet. One refinery and three wet-gas-processing plants were active. All the plants were at Huntington Beach. Socal Oil & Refining Co. operated the refinery, a thermal-cracking plant. Humble Oil & Refining Co., Signal Oil & Gas Co., and Standard Oil Co. of California operated natural gasoline and cycle plants. Despite a lower crude-oil yield, a larger volume of natural gas (all from oil zones) was produced and processed, 12 percent more than in 1960. The combined product output from the wet-gas-processing plants was less in both quantity and value than in 1960. Dow Chemical Co. operated an iodine-extraction plant at Seal Beach and recovered crude iodine from the waste oil-well brines of the Los Angeles basin. At Corona Del Mar, Western Salt Co. harvested crude salt from solar evaporating ponds. The crude product was sold to local consumers for a wide variety of chemical and industrial uses. Some bitterns from the salt works was used for weed control. The R. W. McClellan & Sons peat pit near Huntington Beach yielded peat humus. The unprepared material was sold in bulk as a soil improvement agent. Production decreased about 3 percent.

The 6.5 million ton output of sand and gravel was virtually the same as in 1960. An increased demand for use in building construction was offset by a decline in use for paving. Plants near El Modena, Orange, Anaheim, and San Juan Capistrano produced and prepared more than 500,000 tons each. Sands for abrasive, foundry, and pottery uses were processed near Huntington Beach, Trabuco Canyon, and El Toro. Decomposed granite and miscellaneous stone were quarried near Costa Mesa and elsewhere for road base and for riprap used in flood control projects. Shellmaker, Inc., shipped oystershell from stockpiles near Newport Beach. The shell was prepared for poultry grit. California Nonmetallics mined kaolin in the Trabuco Canyon area, and W.A. Schoeppe Clay Co. produced kaolin northwest of El Toro. Both producers mined a sand-clay mixture, sold some for foundry ganister, and prepared washed kaolin and sand. Miscellaneous clay was dug near Huntington Beach by La Bolsa Tile Co. and near Tustin by Pacific Clay Products Co. for use in manufacturing heavy clay products. Holly Sugar Corp. used a coke-fired vertical kiln to produce lime from purchased limestone at its Dyer beet-sugar plant. Lahabralite Co. exfoliated crude vermiculite imported from Transvaal, South Africa, in an Anaheim plant. The plant product was used as aggregate in plaster, insulation, and concrete.

Placer.—Production of sand and gravel nearly doubled that in 1960, owing chiefly to increased demand in road construction, particularly U.S. Highway 40. Commercial producers and Government contractors operated preparation plants along the Bear River near Auburn and Colfax, and streambed deposits near Lake Tahoe. Joe Chevreaux operated a 250-ton-an-hour plant on the Bear River near Lake Combe and prepared white silica sand for industrial uses, black and white gravels for landscaping, and concrete aggregate for building and paving uses. Sierra Nevada Milling Corp. reworked a quartz tailing on the Bear River near Colfax and ground the material for use in cleansing compounds and as a filter aid. Miscellaneous stone was quarried for rubble and riprap by Government crews and contractors for road base and embankment protection. Fire clays were mined from deposits near Lincoln by Gladding, McBean & Co. and Lincoln Clay Products Co., Inc., for use in manufacturing heavy clay products, firebrick, and block.

Stream gravels were worked by small-scale hand methods at various places and small quantities of placer gold and silver were recovered.

Plumas.—Sand and gravel and stone production increased substantially over 1960 output, owing chiefly to the demand for these materials in constructing the Little Grass Valley Dam. The principal sources for sand and gravel were streambed deposits; stone was quarried near La Porte. Preparation plants were operated near Quincy, Portola, Beckwourth, and Blairsden. Operations at Beckwourth and Blairsden produced only the paving materials required in nearby road-construction projects. The Oroville Project contractors quarried riprap and fill material near La Porte. Maintenance crews for the Western Pacific Railroad Co. used riprap that had been stock-piled at the company Tobin quarry.

Copper ore was shipped from the Engels mine near Greenville to a smelter at Tacoma, Wash., for recovery of contained copper, gold, and silver. Some zinc ore mined at the Lucky S property in the same area contained recoverable gold, silver, copper, lead, and zinc. Cleanup at the Pine Lodge mine in Soda Ravine yielded gold and silver. Placer gold and silver were recovered from stream, bench, and ancient riverbed gravels in various places by numerous prospectors.

Riverside.—Kaiser Steel Corp. operated the Eagle Mountain iron mine throughout the year. Mine output increased 77 percent. No direct-shipping ore was produced. The crude ore was concentrated in a nearby concentrator; iron concentrate output rose 74 percent, and shipments to the Kaiser steel plant in San Bernardino County were 80 percent higher. Exports of iron concentrate increased 26 percent, but the tonnage sold to domestic consumers was somewhat less than in 1960. During the year Kaiser completed about 15,000 feet of diamond drilling at the mine as part of a continuing exploration and development program. Exploration and development at the Storm-Jade iron mine on the north slope of the Eagle Mountains in the Joshua Tree National Monument resulted in stockpiling a small tonnage of iron ore. The ore was obtained by both underground and open-pit methods. No shipments were made from this property in 1961.

Riverside Cement Co. produced general use, moderate heat, and high-early-strength grey portland cement at Crestmore for shipment to customers in California, Nevada, Arizona, and Utah. Riverside's new white-portland-cement plant, adjacent to the grey-cement facility, began producing in May. White cement was shipped to various consumers, chiefly for use in stucco and terrazzo and in constructing swimming pools. Sand and gravel production in the county was 1.9 million tons, only 50,000 tons more than in 1960. Increased needs at Government building and paving projects offset a moderate decline in demand for commercial construction. Substantial quantities of paving sand and gravel were used on county roads. Sand and gravel preparation plants operated near Corona, Mira Loma, Indio, and Banning were the major sources of supply. Riverside Cement Co. mined limestone from its Crestmore underground quarry for use in making cement. H. T. Lucas Mining Co. quarried limestone near Nightingale that was crushed and used for roofing granules. Substantial tonnages of granite, decomposed granite, and miscellaneous stone were quarried near Riverside and Corona for use as building stone, riprap, road base, and roofing granules. Minnesota Mining & Manufacturing Co. operated the largest roofing granule plant in the State in Temescal Canyon near Corona.

Clay pits near Alberhill, Corona, and Elsinore were sources for fire clay and miscellaneous clay used in manufacturing stoneware and pottery; fire brick, block, and mortar; heavy clay products; and various other refractory products. Major producers were Pacific Clay Products Co., Los Angeles Brick & Clay Co., Gladding, McBean & Co., Elsinore Clay Co., and Corona Clay Co. Riverside Cement Co. used material from the Crestmore shale deposit in making cement. United States Gypsum Co. calcined gypsum, which it had mined a few miles west of Midland, in its Midland plant for use in manufacturing plaster, lath, and wallboard. Float wollastonite was collected in the same area and sold for decorative uses. A small tonnage of high-specific-gravity barite was mined at a deposit near Blythe and shipped to a grinder in Kern County. Morongo Corp. dug reed-sedge peat near Banning; most of the air-dried material was shredded and shipped in bulk for soil conditioning at golf courses in southern California. The Prado Dam field was the source for all the crude oil produced. Production came from two producing wells (one in 1960) and the output was nearly 89 percent more than in 1960. Four exploratory wells were drilled; three were abandoned as dry holes, and one was suspended. The total drilling was 16,490 feet.

Sacramento.—More than 27 percent of total dry-gas output in California in 1961 was credited to fields and wells in Sacramento County. Production came from an average of 35 more producing wells than in 1960. Most of the activity centered around the Thornton field where 11 production wells were completed during the year. Eight exploratory wells were drilled for a total of 41,557 feet. All eight wells were abandoned as dry holes.

Larger tonnages of sand, gravel, and stone were required than in 1960 in the multimillion-dollar freeway and building construction projects in and near Sacramento. The leading preparation plants were near Sacramento, Fair Oaks, Del Paso, and Perkins. Each produced more than 500,000 tons from streambed, bench, and ancient riverbed deposits along the American River. Small tonnages of miscellaneous stone were quarried for use in macadam on a Government project. In the Ione area, Industrial Minerals & Chemical Co. and R. J. Robideaux mined fire clay that were sold for use in making firebrick, block, and mortar, and in manufacturing heavy clay products. Cannon Co. dug miscellaneous clay at Michigan Bar, and Sacramento Brick Co. mined similar material near Sacramento. Both companies used the clays in heavy clay products.

The Natomas Co. operated a bucketline dredge on the American River near Folsom to recover placer gold and silver and some platinum group metals. Three sand and gravel washing plants in the same area recovered byproduct gold and silver.

San Benito.—Ideal Cement Co. operated a four-kiln wet-process cement plant at San Juan Bautista to produce general-purpose, moderate-heat, high-early-strength, and plastic portland cements. The plant products were shipped in bulk and bags to customers in California, Nevada, and Oregon. More sand and gravel was produced than in 1960, principally to supply paving projects near San Juan Bautista and construction at Hernandez Dam. Scrapers and power shovels were used to excavate the aggregate. Preparation plants were operated along the San Benito River by the leading producers. Output at stone quarries also increased. Granite Rock Co. quarried granite at Logan for riprap, roadstone, concrete aggregate, and railroad ballast. Ideal Cement Co. quarried limestone near San Juan Bautista for its own use, and FMC Corp. quarried limestone near Hollister for use in its magnesia plant in Alameda County. Fresno Agricultural Chemical Co. mined bentonite from the Lewis pit near Idria for lining ponds and ditches, for lightweight aggregate and foundry use, and as an insecticide and fungicide carrier. Near Tres Pinos, San Benito Clay & Mineral Co. also produced bentonite that was used as a filler in paint and a component in compounding rotary drilling muds.

Ten mercury properties were active, but only one, the New Idria, yielded more than a few flasks of the metal. The New Idria, with both underground and surface workings, was the major mercury producer in the Nation. New Idrea Mining & Chemical Co. did considerable exploration and development work at the property during the year. Exploration and development also was done at three other mercury properties—the Turkey Hill and Valley View mines in the Panoche area, and the Elkafajo mine in the Idria area.

Crude oil production declined 29 percent, owing primarily to the normal decline in older wells. Natural-gas production decreased 61 percent. Dry-gas output, from an average of five more producing dry-gas wells (nearly double the number in 1960), rose 62 percent. All dry-gas production came from the Lomerias area of the Hollister field. Two exploratory wells were drilled for a total of 1,250 feet. Both were dry holes. One was abandoned at 750 feet; the other was suspended at 500 feet.

San Bernardino.—Mineral and natural-saline deposits in San Bernardino County, an area nearly as large as West Virginia, yielded more different mineral commodities than any other State. Total value was greater than in 20 other States, including Nevada.

Cement plants at Colton, Cushenbury, Oro Grande, and Victorville produced and shipped over 13 million barrels of portland cement. These four plants consumed nearly 300 million kilowatt-hours of electric energy. Bulk and bag shipments were made by rail and truck to customers in California, Nevada, Arizona, Utah, Colorado, and New Mexico. The dry-process was used at the 9-kiln Colton plant of California Portland Cement Co. and the 7-kiln Oro Grande plant of Riverside Cement Co. The 9-kiln Victorville plant of Southwestern Portland Cement Co. and the 2-kiln Cushenbury plant of Permanente Cement Co. used the wet process. Permanente announced plans for adding a new 2.7-million-barrel-a-year kiln, which would double annual cement-producing capacity at the plant. The expansion program was expected to be completed by the spring of 1963. Five new dust-collecting units were added at the Oro Grande plant to increase efficiency in removing dust generated by the kilns.

American Potash & Chemical Corp. extracted a wide variety of minerals and compounds at its Trona plant, including sodium borates, boric acid, potassium chloride and sulfate, soda ash, salt cake, crude dilithium-sodium phosphate (converted to lithium carbonate), and elemental bromine from the natural brines of Searles Lake. The elemental bromine and potassium salts produced in the Trona plant were sold to Los Angeles chemical plants and used in manufacturing fertilizer. West End Chemical Co. Division of Stauffer Chemical Co., using a different process, operated a plant at the southern end of the dry-lake playas and produced sodium borate, soda ash, salt cake, and glauber's salt. Bristol Lake brines yielded all the calcium chloride produced in California. California Salt Co. and National Chloride Co. recovered the compound as a crude liquid. Hill Bros. Chemical Co. purchased some of the liquid, which it converted to a flake product. Products from all three plants were marketed in southern California, Nevada, and Arizona chiefly for fireproofing material and as a hygroscopic agent. Crude salt from the brines of Bristol Lake by California Salt Co. and from Searles and Danby Lakes by Pacific Salt Co. was recovered through solar evaporation. Near Amboy, California Salt Co. also mined halite, which it sold for chlorine manufacture.

The Metropolitan Water District of Southern California harvested solar-evaporated salt from Danby Lake brines near Rice and used the product in water softening.

Sand and gravel production rose to 6.1 million tons, about 600,000 tons more than in 1960. Much of the output was consumed in major road-construction projects near Barstow, Baker, Kramer, Johannesburg, and in and near San Bernardino. County road agencies required 300,000 tons of sand and gravel, produced largely by county crews, in maintaining the network of roads. The major producers operated commercial preparation plants in Upland, Rialto, Colton, Redlands, and Highland. Other sand and gravel processing plants were near Victorville, Barstow, Twentynine Palms, and Needles. Limestone was quarried near cement plants and near Wrightwood, San Bernardino, and Yucca Valley. The tonnage of limestone produced for cement was below that in 1960 owing to stockpile carryover, but the quantities quarried for flux, roofing granules, industrial fillers, and use in glassmaking increased. Decomposed granite for road-base material was hauled from stockpiles near Colton, Pomona, Twentynine Palms, and Big Bear Lake or quarried. Marble for terrazzo and building stone was quarried near Stoddard Wells and Big Bear by George Metcalfe, and near Yucca Valley by Art Kurth and Ben Gage. Near the Marmo Diamonte quarries, Kurth and Gage developed a deposit of blue marble, which was used in a hotel front at Palm Desert in Riverside County. Sandstone, quartz, and quartzite were quarried near Oro Grande, Baldwin Lake, Hinkley, Big Bear Lake, and Twentynine Palms for use in cement and rock wool, as a filler, and for foundry and other industrial uses. Miscellaneous stone was quarried at various places for building, landscaping, and roofing granules.

Four producers, at 15 deposits, mined about 40 percent of the State talc output, of which was obtained mostly from deposits in the Tecopa and Silver Lake—Yucca Grove areas. Western Talc Co. was the major producer. In all instances the crude talc was ground in the Los Angeles plants of the producers. Mineral Materials Co. shipped only 16 percent of the output of its Victorite pyrophyllite mine to grinders and stockpiled the remainder. Gladding, McBean & Co. and Southern California Minerals Co. mined ball clay from the Hart property near Ivanpah for use in making floor and wall tile. From the Honey Brown deposit near Vidal, Brown Minerals Co. mined bentonite which it sold for use as a trace mineral in animal feeds. Hectorite was produced from the Hector mine by National Lead Co. and from the Geyser View No. 3 claim by Inerto Co. for use as a clarifying agent at breweries and in cosmetic and pharmaceutical manufacture. Permanente Cement Co. and Riverside Cement Co. dug miscellaneous clay near Lucerne and Oro Grande, respectively, for use in making cement. Near Highgrove, Hancock Brick Co. mined miscellaneous clay, which it used in making heavy clay products. Near Chino, shale was mined and expanded for lightweight aggregate by Shale-Lite Corp. and mined by Pomona Brick Co. for various clay products, including building brick. In Colton, California Portland Cement Co. operated an oil-fired rotary kiln and continuous hydrator to produce quicklime and hydrated lime for the construction industry. Victorville Lime Rock Co., Lucerne Valley, experimented with an oil-fired shaft kiln to produce industrial lime. West End Chemical Co. produced quicklime and hydrated lime at its Searles Lake plant for agricultural, chemical, and industrial uses. The latter lime plant included a rotary kiln and a continuous hydrator equipped to use coke, oil, or natural gas as fuel.

Iron ore from the Iron Age open-pit south of Danby Lake was upgraded and sold principally to iron and steel producers; lesser quantities were consigned to cement manufacturers. Kaiser Steel Corp. mined iron ore at its Silver Lake (Iron Mountain) property, northwest of Baker, from the middle of June through September. About 40 percent of the output was shipped to the company integrated steel plant at Fontana, and the remainder was stockpiled at the Mannix railroad siding. Development work was carried out at the Beck (Kingston Range) iron deposit, northeast of Baker, by Standard Slag Co., but no ore was shipped during the year. The Mountain Pass mine and mill of Molybdenum Corporation of America were active, but less bastnaesite ore was mined and milled than in 1960, and shipments of rare-earth concentrates were somewhat lower. All lead and zinc and most silver output in the county were recovered from lead ores mined at the Silverado, Gold Hill, and Silver Bow mines near Calico.

Ores from the Best Yet mine, the Copper Queen and Joseph claims near Needles, the Last Chance prospect south of the Hector siding, and the O. C. J. No. 1 claim in the Whipple Mountains yielded a high percentage of recoverable copper. The September mine in the Morongo area was the source of ore containing much of the gold recovered in 1961. Placer gold and silver was obtained by various prospectors who worked stream gravels in the Twentynine Palms area.

Nearly 20 percent less crude oil was produced than in 1960 from an average number of producing wells that was unchanged at 22. The Chino-Soquel oilfield was the only field in the county, and no new well completions were reported. Wet-gas production rose 12 percent despite the decrease in petroleum output. Exploratory drilling totaled three wells and 5,497 feet. One well was abandoned at 440 feet; the other two were suspended. All three were reported as dry holes.

From the Pisgah pit west of Ludlow, the Atchison, Topeka & Santa Fe Railway mined volcanic cinder, which it used for railroad ballast. Volcanic cinder and ash from deposits near Cima, Hinkley, and Lucerne Valley were sold for lightweight aggregate, soil-conditioning agents, and landscaping use. Crude barite was mined by Oil Base, Inc., at its Leviathan deposit and by Neal Dollarite at the Silver Bow mine near Yermo; it was shipped to the Los Angeles County grinding plant of Oil Base, Inc. The company reported its intention to abandon the Leviathan property at yearend. In the Clark Mountain area, Pacific Fluorite Co., Inc., suspended fluorspar mining and milling early in the year. It made one shipment in January to a dealer in Ohio. The Juniper fluorspar prospect in the same area was idle except for assessment work.

San Diego.—Sand and gravel production declined from 5.7 million tons in 1960 to 4.4 million tons, owing to lower demand for building and paving uses. A large part of 1961 building construction was in the San Diego, National City, and Oceanside areas. Major freeway contracts were completed early in the year, and other contracts, such as for the four-level interchange in San Diego, required a lightweight (expanded shale) aggregate instead of sand and gravel for the top level. Silica sand was produced and prepared at Oceanside for a variety of industrial uses. Dimension granite was quarried near Escondido and Vista and prepared for architectural building stone and surface plates. Stone used for flagging and in building construction was quarried underground near Ramona. Considerable development was conducted at this property in 1961. Miscellaneous stone and decomposed granite were quarried at various places for use as road base.

Western Salt Co. harvested salt produced by solar evaporation from sea water at its South Bay ponds and processed the crude material in its Chula Vista plant for a wide variety of uses. The bitterns were pumped to the nearby chemical plant of FMC Corp. where magnesium chloride was extracted. Pyrophyllite was produced from three mines in the San Dieguito area. Output from the Organic Mineral Sales, Ltd., Pioneer mine and the Harborlite Corp., Harborlite (Harris) mine was ground in the producers' plants in San Diego. H. G. Golem shipped pyrophyllite from his Four-Gee mine to a Los Angeles chemical company. Virtually the entire output of pyrophyllite was consumed in manufacturing ceramics and insecticides. The city of San Diego reclaimed lime at its Alvarado filtration plant for use in treating water at its Alvarado and Miramar plants. Near Linda Vista, Hazard Bloc Co. and near Del Mar, Union Brick Co. dug miscellaneous clay for their own use in making heavy clay products. In its plant near Escondido, Harborlite Corp. expanded crude perlite, received from producers in Nevada and Arizona. Gold ores mined at the Rose Quartz mine and Eagle Nest group of claims near Pine Valley, and at the Lucky Partner property in the Julian area were amalgamated to recover gold and silver. Beryl was discovered in the Tule Mountain area, north of Jacumba, and exploration of the prospect was in progress at yearend.

San Francisco.—Quarrying and crushing at Candlestick Point supplied stone used in constructing Geary Blvd. and the Alemany Freeway, and in building various improvements at the San Francisco International airport, San Mateo County. Sand for fill was dredged from the Bay and removed from ocean-beach-dune deposits.

San Joaquin.—Natural (dry) gas production was 11 percent more than in 1960, and came from an average of 66 producing wells, an increase of 28. One new field, the Lathrop, was discovered by Occidental Petroleum Corp. with a well completion on October 3. Production came from a 173-foot interval with 4 perforations between 7,230 and 7,642 feet. Initial production from two tests indicated 11,741,000 to 16,119,000 cubic feet a day through a 48/64 bean. Three wells were completed in the field by yearend, and all were shut-in pending pipeline connections. Two new pool discoveries were made in the Walnut Grove field, one by Texaco, Inc., with a well completion on March 8, and one by Brazos Oil & Gas Co., with a completion on August 18. There were 36 dry exploratory wells drilled for a total of 224,046 feet. One of these wells suspended at 3,458 feet; the other 35 were abandoned.

More sand and gravel was produced than in 1960 for county use as well as for shipment to neighboring counties. Producers worked the streambed gravels of the Mokelumne River near Clements, the Calaveras River near Bellota, and the alluvial fan of Corral Hollow Creek near Tracy. Miscellaneous stone was quarried for riprap by Government contractors. From purchased limestone, the Holly Sugar Corp. at Tracy and Spreckels Sugar Co. at Manteca, both using shaft-type kilns, produced lime for their own use. Pacific Clay Products Co. mined fire clay near Tracy, and California Clay Products Co. and Stockton Building Materials Co. dug miscellaneous clay from pits in the Stockton area. In all instances, the producers used the clays in manufacturing heavy clay products.

Prospectors worked stream gravels at various places to recover placer gold and silver.

San Luis Obispo.—An average of 195 producing wells (1 less than in 1960) yielded 10 percent less crude petroleum and 9 percent less natural (wet) gas. Production came from five fields—Guadalupe, Arroyo Grande, Morales Canyon, Russell Ranch, and Taylor Canyon. Activity in 1961 centered in Guadalupe field; eight well completions were made in the Guadalupe field and one in the Arroyo Grande. Five exploratory dry holes totaling 19,703 feet were drilled in the San Joaquin Valley area. All natural-gas production came from oil zones. A thermal-cracking plant at Arroyo Grande was operated by Union Oil Co. and a natural gasoline and cycle plant near Cuyama, by Richfield Oil Corp. Output of natural-gasoline and cycle products was 28 percent less, but the volume of LP gas produced was 4 percent larger than in 1960.

Of five active mercury mines, only the Buena Vista open-pit mine near Klau yielded more than 40 flasks of mercury. The Buena Vista mine ranked second as a producer of mercury in the State, and ores from this property were furnaced to yield more than 2,700 flasks during the year. The Cambria mine, a few miles north of Cambria, ranked second in county production. Coast Mine Co. retorted some high-grade cinnabar from this mine and recovered 40 flasks of mercury.

The demand for sand and gravel and stone was substantially below that in 1960, although the quantities of sand and gravel produced for building purposes in San Luis Obispo and Arroyo Grande were larger. Paving projects were limited to highway improvements near Atascadero and San Luis Obispo. Specialty sand was produced near Oceano for foundry use. Building stone, riprap, and road-base material were quarried near Nipomo, Adelaide, Paso Robles, and Morro Bay. Limestone quarried at Lime Mountain near Adelaide was shipped for use as metallurgical flux, for production of lime used in sugar refining, and for agricultural use. Superior Gypsum Co. mined gypsum at its Carisso property near Simmler for agricultural use. San Luis Brick, Inc., dug miscellaneous clay for its own use from a pit near the San Luis Obispo city limits.

San Mateo.—Ideal Cement Co. dredged oystershell and clay together from San Francisco Bay and used the mixture as raw material to produce portland cement in its four-kiln wet-process plant at Redwood City. Bulk and bag shipments of cement were made by truck, rail, and boat to customers in California, Nevada, Oregon, Washington, and foreign countries. A small quantity of oystershell was used outside the county in preparing poultry grit. Stone production declined owing chiefly to fewer paving projects in 1961. Quarries near Redwood City, Woodside, and Pescadero supplied drain rock and base material used in road and building construction. Concrete aggregate and roadstone were produced at limestone and sandstone quarries near Brisbane, Belmont, and Rockaway Beach. Sand and gravel was produced at Pilarcitos Creek near Half Moon Bay and by Government contractors for concrete aggregate. Some sand was shipped into the county by truck and rail.

Leslie Salt Co. harvested a large tonnage of crude salt from solar evaporation ponds that extended into Alameda and Santa Clara Counties. The salt was processed at the company's Redwood City plant and virtually all of it was exported or shipped out of State. Merck & Co., at a chemical plant in South San Francisco, extracted magnesia from sea water, using a purchased limestone-dolomite mixture as a precipitant.

Nearly 20 percent less crude petroleum and 41 percent less natural (wet) gas were produced from an average of 18 productive wells, compared with an average of 16 wells in 1960. A new pool discovery in the La Honda field was made by Neaves Petroleum Developments with a well completion on February 11. Initial production (pump) was 56 barrels a day of 26.5° API-gravity petroleum from the interval between 2,487 and 2,517 feet. One additional well was completed in the La Honda field in 1961, and nine dry exploratory holes totaling 24,025 feet were drilled. The Oil Creek area produced during the year, but no drilling was reported.

Santa Barbara.—Production of crude petroleum and natural gas from oil zones declined 2 and 1 percent, respectively, from 1960. Most of the drilling activity was in offshore fields. During the year, 15 well completions were made in the Conception offshore field; 10, in the Cuarta offshore field; and two, in the Coal Oil Point offshore field. The last two wells were in a new pool discovery. The dry-gas output was five times that in 1960, and the increase was credited to two wells in the Gaviota offshore gasfield and to one in the Cuarta Canyon offshore gasfield. There was one new well completion in the Naples offshore gasfield. (In 1960 the dry-gas production came from only two wells, one each in the Coal Oil Point and Gaviota offshore fields.) The number of natural gas and cycle plants remained unchanged at six, as Shell Oil Co. closed its Santa Maria plant during the year, and Texaco, Inc. placed its Gaviota plant on stream. Output from these plants exceeded that of 1960 by nearly 25 percent for natural gasoline and cycle products, and by 17 percent for LP gases.

Johns-Manville Products Corp. and Great Lakes Carbon Corp. processed diatomite from deposits near Lompoc in nearby plants, principally for filtration and insulation uses. Near Santa Maria, The Airox Co. mined and processed diatomite for use as lightweight aggregate and pozzolan. Early in the year, Wyandotte Chemical Corp. abandoned its open-pit diatomite operation west of Lompoc and removed all mill machinery and equipment.

Larger quantities of sand and gravel and stone were required for building and paving projects in the Santa Maria and Lompoc areas, and at the Vandenberg Air Force Base and Point Arguello Naval Facility, than in 1960. Substantial quantities of aggregate and road-base material were consumed in constructing the Santa Maria Freeway. Much of the sand and gravel was produced from streambed deposits near Solvang, Santa Maria, Buellton, Goleta, Lompoc, and Sisquoc. Dolomitic limestone was quarried in Miguelito Canyon south of Lompoc. Sandstone was quarried near Goleta, Santa Maria, and Carpenteria for building stone, riprap, and road-base material. Dimension building stone was quarried near Lompoc and at Tepusquet Canyon near Santa Maria. The Union Sugar Division, Consolidated Foods (Chicago), produced lime from purchased limestone, in coke-fired kiln and used the lime in its Betteravia beet-sugar plant.

The Gibraltar mercury mine was the only active metal mine in the county in 1961. Cinnabar ore from this open-pit operation was furnaced to recover mercury.

Santa Clara.—Permanente Cement Co. operated a 6-kiln wet-process cement plant, largest cement plant in the State, at Permanente. Portland and masonry cements were shipped to customers in California, Nevada, Oregon, Washington, Alaska, Hawaii, and foreign countries.

Construction of roads, road structures, and streets in the San Jose area required more sand and gravel and stone than in 1960. Sand and gravel was obtained mostly from streambed and flood-plain deposits near San Jose, Gilroy, and Cupertino. Limestone was quarried at Permanente for use in cement and for sale as road base; nearly 7,000 feet of blast-hole drilling was completed in 1961. The Saratoga stone quarry was worked by county road crews for rubble and roadstone. Quarries near San Jose, Milpitas, Los Altos, Saratoga, and Gilroy supplied base rock and roofing granules used in dwelling-unit construction. Gladding Bros. Manufacturing Co. and Remillard-Dandini Co. mined miscellaneous clay from pits in the San Jose area and used it in manufacturing heavy clay products. Mother Lode Rock Industries, Inc., produced magnesite from the Western quarry and sold it to an Alameda chemical plant. The company relinquished its lease on the quarry before yearend.

The New Almaden and Guadalupe mines yielded virtually all the mercury recovered in 1961. Eleven lessees worked various areas of the New Almaden property and recovered more than 1,000 flasks of mercury. Considerable exploration and development was completed on the leases during the year. Andy's Mercury Reduction Plant, which took over the Crystal Ball Mining Co., recovered about 73 percent of the mercury produced in the county in furnacing ores from the San Francisco pit and San Cristobal tunnel of the New Almaden property. Palo Alto Mining Corp. and Wilson Anderson Oil Co. retorted ores from the Guadalupe mine. The Silver Creek mine near Evergreen yielded a few flasks of mercury; the property was closed before yearend.

Santa Cruz.—Pacific Cement & Aggregates, Inc., produced two types of portland cement in its nine-kiln dry-process plant at Davenport. Bulk and bag shipments were made by truck and rail to customers in northern California. Shale, quarried by the company near Davenport and by Ideal Cement Co. from the Chittenden quarry near San Juan Bautista, was used in making cement. A comparatively small quantity of flue dust from the Davenport plant was sold for fertilizer because of its potash content.

Large quantities of sand from the Santa Margarita formation near Felton were shipped to Bay area counties for use in plaster and concrete. The new 300-ton-an-hour sand facility of Henry J. Kaiser Co. near Felton was in full operation. The plant had dual water scalpers and four screw-type classifiers. Limestone quarried near Davenport and Santa Cruz was used in making cement and prepared for poultry grit and rubble. Sandstone from a quarry near Davenport was used in the Half Moon Bay breakwater, San Mateo County, which was completed in 1961. Quarries near Felton and Soquel, and the county's Empire quarry supplied much of the riprap and roadstone required during the year.

Shasta.—Substantial quantities of sand and gravel were produced in the Redding and Hazel Creek areas for aggregate used in lining the 11-mile Clear Creek tunnel. When completed, this tunnel will transfer water from the Trinity River basin to the Sacramento River. The water will be used to develop power and for irrigation. Appreciable tonnages of sand and gravel, obtained from the same sources, were used in major road-construction projects near Shasta and Whiskeytown, and in the Dunsmuir area of Siskiyou County. Stone was quarried by county crews for riprap used in embankment protection, and by Bureau of Reclamation contractors as foundation base in powerplant construction. State highway crews mined volcanic cinder for use in road maintenance. Deposits near Glenburn and Fall River Mills supplied cinder for local road repair and maintenance.

The old Hirz Mountain (Jennings Group) iron property was reactivated by Don Clifton, and exports of iron ore began in March. Mountain Copper Co., Ltd., shipped iron (magnetite) ore from the Iron Mountain deposit to Alameda County where it was used to help anchor a new traffic tube from Oakland to Alameda. Mountain Copper also produced and shipped pyrite fines and concentrates to Bay Area chemical companies as a source of sulfur used in making sulfuric acid and liquid sulfur dioxide. The cinder residue from the roasting process was used in making special cements and as a soil supplement. Gold ores mined at the Washington mine near French Gulch and at the Yankee John mine southwest of Redding yielded gold and silver. Gold ore from the Potosi mine near Igo was treated to recover gold and silver. Stream gravels, old tailings, and ancient riverbeds were worked at various places, and relatively minor quantities of placer gold and silver were recovered.

In December the highly automated dry-process-cement plant of Calaveras Cement Co. was completed at Redding, and a kiln-firing ceremony was held on the 15th of the month. The oil fuel for the kiln was to be replaced by natural gas as soon as the gas could be made available from the Alberta-California pipeline.

Sierra.—Six lode gold mines were active; however, only the Brush Creek mine near Goodyears Bar and the Original 16 to 1 mine at

Alleghany yielded significant quantities of gold and silver. Placer gold and silver were recovered in varying quantities by individuals who worked ancient riverbed and stream gravels.

Sand and gravel produced and prepared by Government crews and contractors was used in roads and road structures. Much of the output was used on State Highway 49 near Downieville, Sierraville, and Loyalton. Reno Silica Co. shipped quartz from its quarry stockpile near Crystal Peak. The company completed about 1,200 feet of exploratory drilling in 1961.

Siskiyou.—Government crews and contractors produced and prepared sand and gravel and stone for use in highway improvement and for structural uses at the Iron Gate Dam development. Output of these products was less than in 1960, owing principally to completion of sections of U.S. Highway 99. Commercial preparation plants at Yreka and Mt. Shasta provided aggregate used in building and paving. Volcanic cinder was mined for railroad ballast from the Kegg Cinder Pit north of Bray and from the Porcupine Pit northeast of Hambone. Pits near Tulelake and Weed yielded cinder prepared for lightweight aggregate used in making concrete brick and block. Lesser quantities were used in building roads and driveways and in landscaping.

Six lode gold mines were active in the Klamath River and Scott River areas; however, most of the recoverable gold and silver was obtained during cleanup operations at the Siskon mine near Happy Camp. The cleanup also yielded some recoverable copper. Placer gold and silver were recovered by a number of individuals who worked stream, bench, and ancient riverbed gravels, particularly in the Klamath, Scott, and Salmon Rivers. Most of the gold and silver recovered came from the Hickox drift mine on the Salmon River.

Solano.—Natural gas production (all from dry-gas zones) was virtually unchanged from 1960. An average of 113 dry-gas wells compared with 102 in 1960 were productive. Standard Oil Company of California made one pool discovery in the Suisun Bay field with a well completed on September 25. Initial production on fractional day test was 2,240,000 cubic feet through a 24/64 bean. There were two productive intervals, one from 4,015 to 4,068 feet, and one from 4,890 to 5,121 feet. One additional well was completed in the pool before yearend. Drilling was about equally divided between the Bunker and Liberty Island fields. The Bunker field had four well completions during the year; the Liberty, five. County crude-oil output came from only one oil well in the Winters gasfield. The volume produced was nearly 27 percent below that in 1960.

Basalt and miscellaneous stone were quarried in the Benecia, Thomasson, and Blue Rock Springs areas for use as concrete aggregate and roadstone. Sand and gravel was produced from pits near Winters, Suisun, Vacaville, and Vallejo. Most of the pits were in streambed deposits of Putah Creek.

Sonoma.—Building and paving activities required more sand and gravel than in 1960. Nearly 2.6 million tons of aggregate was produced from streambed deposits of the Russian River near Healdsburg, Cloverdale, Mirabel Park, and Windsor, and in Sonoma Creek near Aqua Caliente. Basalt Rock Co., Inc., operated preparation plants at its two deposits south of Healdsburg and was the major sand and gravel producer in the county. Riprap, roadstone, and drain rock were produced at basalt and miscellaneous-stone quarries near Petaluma, Forestville, Occidental, Cotati, and Sonoma. The Trinity and Valley of the Moon quarries near Glen Ellen supplied dimension building stone and flagging. Shale obtained from the Mark West quarry northeast of Santa Rosa was used for base material and fill in roadways. In May, Joe Malugani purchased the Mark West quarry from A. J. Snodgrass.

An average of five wells, compared with three in 1960, were productive, at the only gasfield (Petaluma) in the county, and production rose nearly 100 percent over that in 1960. Two new wells were completed in the Petaluma field during the year. One exploratory well was drilled, but abandoned as a dry hole at 1,750 feet.

Mercury was produced at the Culver-Baer (Buckman) mine in the Geyser area and the Mt. Jackson-Great Western mine near Guerneville. In August, operations at the latter property were suspended by Sonoma Quicksilver Mines, Inc., and resumed about a month later by Glenn Truitt & Associates. Output exceeded 2,500 flasks of mercury.

Stanislaus.—Building and road-construction, particularly in the Modesto area, required more sand and gravel than in 1960. The principal producers worked streambed and flood-plain deposits of the Tuolumne and Stanislaus Rivers and Orestimba Creek. Sand and gravel preparation plants were near Modesto, Hughson, Waterford, Riverbank, Oakdale, and Newman. Decomposed granite was quarried by State highway crews for use in road maintenance and repair. In the Oakdale area, E. H. Metcalf Materials dug ball clay for use in whiteware, fire clay for mortar and rotary drilling muds, and miscellaneous clay used in heavy clay products. Western States Minerals Co. mined fire clay near Knights Ferry for heavy clay products and ball clay for use in whiteware, pottery, and floor and wall tile. In the same area, Lester Raggio produced and sold fire clay for use in stoneware. Kraftile used fire clay obtained from a deposit near LaGrange in making heavy clay products.

Except for 4 ounces of gold recovered by panning gravels along the Tuolumne River, all gold and silver was recovered as a byproduct by the Putnam Sand & Gravel Co. nonfloating washing plant a few miles southeast of Waterford.

Sutter.—Five new gasfield discoveries were made. On April 4, Occidental Petroleum Corp. completed the discovery well in the West Butte field. Production came from four perforations with a combined interval of 62 feet. The initial test flowed 2,271,000 cubic feet through a 15/64 bean. Three additional wells were completed in this field by yearend. A second gasfield discovery (Butte Creek) was made by the same company with a well completed on September 4 and shut in the same day. A test on September 3 indicated a flow of 752,000 cubic feet through a 24/64 bean from a single perforation and a productive interval of 17 feet. Sacramento Oil & Gas Co. made a well-completion discovery in the Nicolaus gasfield on July 14; this well flowed initially at 5,200,000 cubic feet through a 24/64 bean from a 15-foot interval. Two discoveries were made in August. The most promising of the two, the Sutter City field, was discovered by Atlantic Oil Co. on August 3. There were five perforations with a combined productive interval of 119 feet. Initial production was 10,000,000 cubic feet a day at 1,600/2,000 psi. Four additional wells were completed in the field, and all were shut in at yearend. On August 23, T. A. Atkinson brought in a gas-well discovery in the Tisdale field. Under test the well flowed 8,977,000 cubic feet a day at 2,245/2,525 psi from two perforations, one 26-foot interval and one 78-foot interval.

In addition to field discoveries, 26 other wells were drilled for a total of 193,435 feet; all were abandoned as dry holes. Despite the new drilling successes, additional completions in established fields, and an average of 11 (1 more than in 1960) producing gas wells during the year, the dry-gas yield was nearly 45 percent below that of 1960.

Paving aggregate was produced from the Bear River sand and gravel deposits near Rio Oso for use in rerouting State Highway 24. The Sutter Buttes area west of Live Oak was the source of sand and gravel used locally for fill and road base and in construction at a Titan missile base. Riprap was quarried in the Sutter Buttes area. Gladding, McBean & Co. mined miscellaneous clay near Nicolaus and used the material in heavy clay products.

Yuba Milling Co., Division of Metals Disintegrating Co., Inc. operated a nonmetallic-mineral custom grinding plant in Sutter.

Tehama.—The initial phase of the Red Bluff Division Dam and related structures required substantial tonnages of sand and gravel for aggregate and fill and of stone for riprap and fill. Most of the sand and gravel used for general building and paving came from deposits near Red Bluff and Richfield. In October the plant of Red Bluff Sand and Gravel Co. was sold. The new owner leased the plant to Ransome Co. which operated it the rest of the year. The interests of Martin Bros., Inc., near Richfield were sold to Thomas Creek Sand & Gravel Co. State highway crews mined and used volcanic cinder for road maintenance.

The three dry-gas fields in the county yielded nearly 50 percent more natural gas than in 1960. Production came from an average of 11 producing wells, an increase of 6 over the number in 1960. There were four new well completions in 1961—three in the Kirkwood field and one in the Corning field. Ten exploratory wells were drilled to a combined total of 40,807 feet, and all were abandoned as dry holes.

Trinity.—Sand and gravel production was higher than in 1960. Comparatively large tonnages of aggregate were used in roads and road structures in the initial construction work at the Lewiston Dam, and in bridges, powerplant structures, and fish-hatchery units built as a part of the Trinity River Division of the Central Valley Project. Building and paving sand and gravel requirements were supplied by Bureau of Reclamation contractors and by the Trinity Sand & Gravel Co. at Weaverville. M. W. Brown produced a substantial quantity of paving aggregate near Trinity Center. Stone for riprap was quarried in the Island Mountain area and used in constructing and maintaining railroad embankments.

Gold ores from the Layman mine near Hayfork and the Montezuma mine east of Lewiston were treated to recover gold and silver. Two small suction dredges and a hydraulicking operation worked gravels along the Trinity River to recover gold and silver; however, most of the placer gold and silver was recovered by individuals who worked the gravels by small-scale hand methods.

Tulare.—Mineral-fuel output came from one gasfield (part of the Trico field) with an average of 59 productive wells (21 more than in 1960) and the Deer Creek oilfield with an average of 22 wells (one more than in 1960). One new well was completed in the Tulare County part of the Trico gasfield, and five new wells were completed in the Deer Creek oilfield. Despite this apparent increase in activity, dry-gas production declined 4 percent, and the crude-oil yield rose only 2 percent. Four additional exploratory wells were drilled during the year; two wells were abandoned as dry holes, and two were suspended.

Large tonnages of sand and gravel and stone were prepared for use by the U.S. Army Corps of Engineers in constructing Terminus Dam and the associated structures and roads near Lemon Cove. Increased quantities of sand and gravel and stone were produced for building and paving projects of Government road agencies, the Federal Bureau of Reclamation, and the National Park Service. Commercial producers and contractors worked flood-plain deposits of the Kaweah and Tule Rivers to produce sand and gravel in the Lemon Cove and Porterville areas. Granite and limestone were quarried near project sites for use in dam and road construction. Macco Corp. mined crude barite in 9-mile Canyon from The Barite King and Queen mines. Southwestern Minerals, Inc., mined crude barite at the Finn mine. All mine production was shipped to the Macco Corp. processing plant in Kern County. S. P. Brick Co. mined miscellaneous clay near Exeter for its own use in making brick and other heavy clay products.

Tuolumne.—Sand and gravel produced in the county was used chiefly in reconstructing State Highway 108 near Dardanelle, the Big Oak Flat section of State Highway 120, and in a water and power project near Groveland. County maintenance crews quarried riprap and roadstone near Long Bar, Columbia, and Chinese Camp for their own use. Granite quarried at Drew Meadow by employees of the Hetch Hetchy Water & Power Department was used for road base. Limestone from the Sonora underground quarry was used in making lime for use in manufacturing paper and in refining sugar. Marble was quarried in the Sonora area for use as terrazzo. Miscellaneous stone from the Tune quarry near Twain Harte was used for roofing granules and as base and surface material in roads. U.S. Lime Products Division, The Flintkote Co., produced quicklime and hydrated lime in its Sonora plant for use by construction, agricultural, chemical, and other industries. Pacific Clay Products Co. quarried shale near Sonora and used the material in manufacturing heavy clay products.

Gold ore obtained from the Hidden Treasure mine near Italian Bar in 1961 and from the Confidence mine, near Confidence, in 1934 and treated in 1961 contained recoverable gold and silver. Some free gold was recovered at the Golden Rule mine near Sonora. A few ounces of placer gold was recovered from stream gravels by panning.

Ventura.—Crude-oil production declined 7 percent despite an average of 43 more productive wells than in 1960. There was considerable drilling, most of which was centered in the Ventura (20 new well completions), Rincon (12), and Montalvo West (11) fields. No new fields or pools were discovered. Thirty-two exploratory wells were drilled totaling 179,798 feet; 24 of these were abandoned as dry holes, and 8 were suspended. Natural-gas output (from oil zones) declined 2 percent in 1961. Dry-gas production, all from the gas zone of the Montalvo West field, increased 23 percent; the number of producing wells was 2 in both 1960 and 1961. The number and locations of operating refineries and natural gasoline and cycle plants were the same as in 1960. Output decreased 5 percent for natural gasoline and cycle products and increased 4 percent for LP gases.

Building construction and road paving at the Point Mugu Naval Missile Center, freeway projects on U.S. Highways 101 and 399, and various construction jobs in the Oxnard, Ventura, and Ojai areas required substantially larger tonnages of sand and gravel than were produced in 1960. Most of the aggregate and base material for roads and building foundations came from plants in the El Rio, Saticoy, and Santa Paula areas near the Santa Clara River. Plants also were operated near Santa Susana, Thousand Oaks, and Moorpark. Near Santa Susana, Western Lime Products Co. quarried decomposed oystershell which was used as a filler in fertilizers and animal feeds and for poultry grit. Sandstone and miscellaneous stone were quarried near Oxnard and Camarillo for use as riprap in breakwater and levee construction and for boat-harbor improvements. Stone quarries near Ojai, Fillmore, and Simi supplied dimension building stone. Shale, quarried near Ventura by Rocklite Products, Inc., and near Frazier Park by Ridgelite Products, Inc., was expanded by the producers for use as lightweight aggregate. Crude gypsum mined in Quatel Canyon, south of Maricopa, by Monolith Cement Co. was consumed in the producer's Kern County cement plant.

Yolo.—Sand and gravel produced along Cache Creek near Madison, Yolo, and Woodland was prepared for use as aggregate and road-base material. Much of the output was consumed in constructing and maintaining State and county roads, including the new Yolo Causeway and projects in the Dunnigan, Brooks, and Davis areas. American Crystal Sugar Co. at Clarksburg and Spreckels Sugar Co. at Woodland used coke-fired shaft-type kilns to produce lime from purchased limestone for their own needs.

A new gasfield discovery (Sacramento By-pass field) was made by Phillips Petroleum Co. with a well completion on November 12. Under test the well flowed 1,392,000 cubic feet a day from a 7-foot productive interval under 700 psi through a 24/64 bean. There were two new well completions in the Winters field during the year and one in the Dunnigan Hills field. Despite the apparent increase in activity and in average number of productive wells, dry-gas production declined 9 percent from that in 1960. Sixteen unsuccessful exploratory wells were drilled to a total of 128,685 feet; all were abandoned as dry holes.

The Reed mercury mine and mill was operated by Universal Silvers, Inc. Only a small tonnage of new ore was mined and furnaced, and most of the more than 1,000 flasks of mercury produced was recovered in processing old tailings and ore mined in 1960. Considerable exploration and development was completed by the operator during 1961.

Yuba.—The principal placer-gold operation in the State was on the Yuba River near Marysville. Yuba Gold Fields Division, Yuba Consolidated Industries, Inc., operated four bucketline dredges in the area and recovered gold, silver, and platinum-group metals. A high percentage of the output of these metals in California was credited to this operation. All other placer gold and silver in the county was recovered by miners and prospectors who worked stream gravels by small-scale hand methods. Gold ore mined from the Good Hope property near Waldo Junction was treated to yield gold and silver; the Good Hope was virtually the only lode mining operation that produced any significant quantity of metal.

Streambed deposits and dredge tailings in the Marysville area were the chief sources for sand and gravel produced and prepared for concrete aggregate, road base and drain rock, and sand for plaster, blast and engine uses. Much of the output was consumed in building and road construction on State Highways 20 and 24 in the Marysville area. Some of the material was trucked into neighboring counties for structural and paving use. A clay pit near Wheatland yielded miscellaneous clay used by Gladding, McBean & Co. in manufacturing draintile and sewer pipe.

The Mineral Industry of Colorado

By D. H. Mullen[1]

THE VALUE of mineral production from the mines, quarries, and wells in Colorado in 1961 was $343.3 million, a slight gain over that of 1960. Declines of less than 1 percent in the value of the mineral fuels and metals were recorded, whereas there was a 5-percent increase in the value of the nonmetallic minerals. Of the mineral fuels, coal increased 8 percent because of increased consumption by The Colorado Fuel and Iron Corp. (CF&I) at its steel plant at Pueblo and because of the continued rise in coal consumption at thermal electric plants. Gains also were recorded in the value of natural gas liquids recovered at natural gas plants and peat. In 1961 the values of carbon dioxide and crude petroleum produced declined 5 percent and 2 percent, respectively. The drop in petroleum output resulted from lower output at the Adena-Adena South field in Morgan County and the Rangely field in Rio Blanco County, the two "giant" fields (production plus reserves equal 1 million barrels or more) in the State. Both of these fields were under unit operation with long-range programs for secondary recovery through waterflooding—methods that will result in a sustained rate of output over a considerable period of years. Production from new discoveries did not equal the decline in output from the two "giant" fields.

Gains in value of production were recorded for all of the metal commodities except lead, molybdenum, and uranium ore. Lead production was curtailed because of the continued low price. Greater quantities of molybdenum and uranium ores were mined; however, the metal content of each was lower, which resulted in a decline in value for each.

Of the nonmetals produced, seven gained and seven lost in value of output. Two of the major nonmetal commodities that showed large increases were cement and stone. The very substantial advance in the value of lime cannot be compared with that of 1960 because captive lime production by processors of beet sugar was included for the first time in 1961. Gains and losses of the remaining nonmetal commodities were minor.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

TABLE 1.—Mineral production in Colorado [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate________short tons, gross weight__	304	$53	819	(2)
Carbon dioxide (natural)__________thousand cubic feet__	155,871	20	167,872	$19
Clays____________________________thousand short tons__	490	1,424	556	1,241
Coal (bituminous)_________________________________do____	3,607	21,090	3,678	22,787
Copper (recoverable content of ores, etc.)___short tons__	3,247	2,085	4,141	2,485
Feldspar___________________________________long tons__	(2)	(2)	14,129	99
Gem stones____	(3)	45	(3)	36
Gold (recoverable content of ores, etc.)__troy ounces__	61,269	2,144	67,515	2,363
Gypsum___________________________thousand short tons__	82	296	85	320
Iron ore (usable)____thousand long tons, gross weight__	11	80	27	190
Lead (recoverable content of ores, etc.)_____short tons__	18,080	4,231	17,755	3,658
Lime_____________________________thousand short tons__	(2)	(2)	75	1,319
Mica (scrap)_______________________________short tons__	340	4	600	10
Natural gas_________________________million cubic feet__	107,404	12,781	108,142	12,544
Natural gas liquids:				
Natural gasoline__________________thousand gallons__	73,179	4,138	76,880	3,627
LP gases_______________________________________do____	104,275	4,938	115,410	5,498
Peat_______________________________________short tons__	9,384	37	9,894	44
Petroleum (crude)_________thousand 42-gallon barrels__	47,469	137,660	[4] 46,746	[4] 134,628
Pumice__________________________thousand short tons__	32	70	44	60
Sand and gravel_________________________________do____	19,053	16,882	18,360	16,946
Silver (recoverable content of ores, etc.) thousand troy ounces__	1,659	1,502	1,965	1,817
Stone____________________________thousand short tons__	2,442	4,651	2,451	5,301
Tin (content of concentrate)________________long tons__	10	12	(2)	(2)
Uranium ore_______________________________short tons__	1,149,583	23,462	1,282,462	21,509
Vanadium____do____	4,026	(2)	4,149	(2)
Zinc (recoverable content of ores, etc.)____________do____	31,278	8,070	42,647	9,809
Value of items that cannot be disclosed: Cement, fluorspar, molybdenum, perlite, pyrites, salt, tungsten concentrate, and values indicated by footnote 2______	____________	99,743	____________	99,860
Total Colorado [5]______________________________	____________	[6] 343,104	____________	343,256

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Weight not recorded.
[4] Preliminary figure.
[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.
[6] Revised figure.

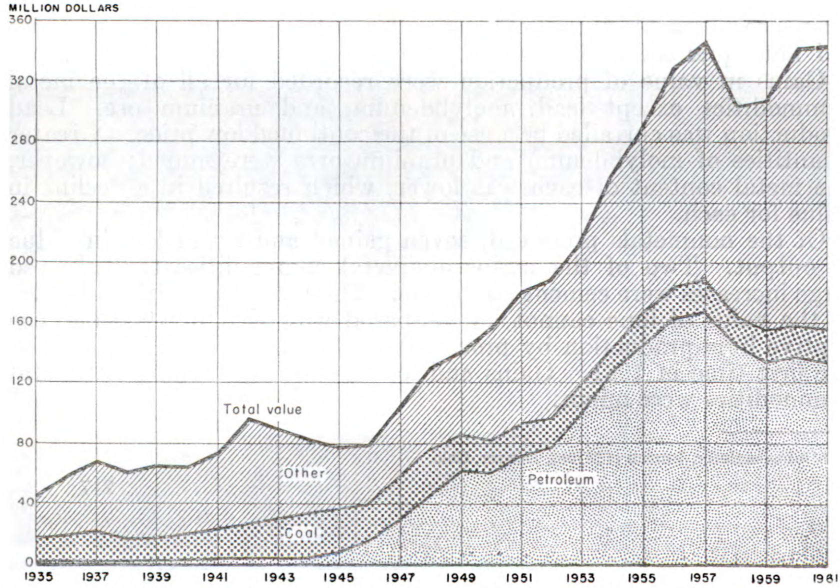

FIGURE 1.—Value of petroleum and coal and total value of all minerals produced in Colorado, 1935–61 (excludes uranium 1941–55).

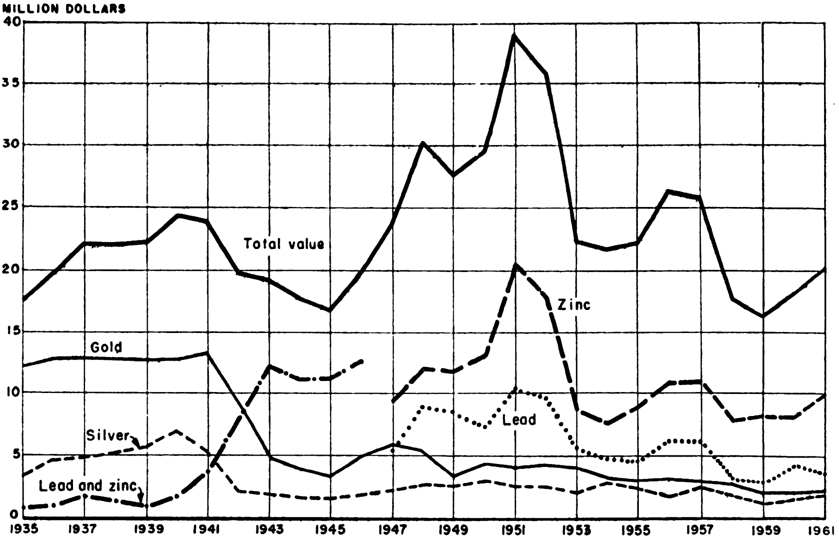

FIGURE 2.—Value of mine production of gold, silver, lead, and zinc and total value of these minerals (including copper) in Colorado, 1935–61.

Employment and Injuries.—Final data for 1960 and preliminary data for 1961 compiled by the Bureau of Mines for employment and injuries in the Colorado mineral industries, excluding the petroleum industry, are shown in table 2.

TABLE 2.—Employment and injuries in the mineral industries [1]

Industry	Number of operations [2]	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Nonfatal	
1960:						
Nonferrous mines, mills, and smelters (excluding uranium)	195	1,712	2,808,415	1	198	70.9
Uranium mines and mills	461	2,887	5,524,488	7	218	40.7
Ferrous mines and mills	7	975	2,772,905	--------	66	23.8
Sand and gravel plants	207	1,203	1,787,901	--------	43	24.1
Stone quarries and plants	121	589	1,141,407	--------	27	23.7
Nonmetal mines and mills (other than sand and gravel and stone)	84	508	860,957	2	45	54.6
Coal and coke	120	2,423	3,672,728	2	154	42.5
Total	1,195	10,297	18,568,801	12	751	41.1
1961: [3]						
Nonferrous mines, mills, and smelters (excluding uranium)	233	1,653	2,897,521	--------	202	69.7
Uranium mines and mills	348	2,626	5,129,515	3	144	28.7
Ferrous mines and mills	11	1,109	3,130,316	3	73	24.3
Sand and gravel plants	282	1,163	1,865,868	1	15	8.6
Stone quarries and plants	139	712	1,284,307	--------	31	24.1
Nonmetal mines and mills (other than sand and gravel and stone)	94	456	655,076	--------	6	9.2
Coal and coke	119	1,926	3,267,322	6	113	36.4
Total	1,226	9,645	18,229,925	13	584	32.7

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Preliminary figures.

Government Programs.—General Services Administration (GSA) purchased beryllium concentrate (beryl) from Colorado deposits at its buying station at Custer, S. Dak.

Two Office of Mineral Exploration (OME) contracts were executed in 1961, one to Humphreys Exploration Co. for exploration for silver-lead-zinc ore in Mineral County and one to Consolidated Parnett Corp. for exploration for lead-zinc ore in Summit County. Total amount of the loans was $237,000 with a 50-percent participation by the Government.

Public Law 87–347, approved in October, provided for benefit payments to eligible, small domestic lead-zinc producers, beginning in January 1962. The program, which was to operate through 1965, was designed to alleviate some of the distress in the industry resulting from low metal prices. By the close of the year, inquiries had been made regarding this law by several Colorado lead-zinc mine operators.

Public Law 87–300, approved in September, provided for a comprehensive study of health and safety conditions in metal and nonmetal mines. The Secretary of the Interior through the Bureau of Mines inaugurated a detailed program for collecting data and inspecting mines during 1962. A complete report of the findings was to be submitted to the Congress in September 1963.

The Bureau of Mines, through its Denver office, continued its widespread and comprehensive investigation of the occurrence, reserves, utilization, and economics of mineral deposits in the eight States comprising Region III. Reports[2] of the investigations and studies were published.

A series of mineral studies and 34 mineral examinations of proposed reservoir sites were made under the interagency Missouri River Basin Project that contributed to the land, water, and power developments of other agencies—principally the Federal Bureau of Reclamation and U.S. Army Corps of Engineers.

The Bureau of Mines, at Denver, continued engineering research and rock mechanics studies as applied to ground control. Engineering research was emphasized in three categories: Sampling-methods research, mine-systems analysis, and operations research applied to problems of mineral exploration. Reports[3] describing results of the investigations were published.

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[2] Dale, V.B. Tungsten Deposits of Gila, Yavapai, and Mohave Counties, Ariz. BuMines Inf. Circ. 8078, 1961, 104 pp.

Dare, W. L. Mining Methods and Techniques Used at the Radon Longwall Operations, Hecla Mining Co., San Juan County, Utah. BuMines Inf. Circ. 8004, 1961, 54 pp.

———. Uranium Mining in the Lukachukai Mountains, Apache County, Ariz., Kerr-McGee Oil Industries, Inc. BuMines Inf. Circ. 8011, 1961, 30 pp.

Dow, V. T. Magnetite and Ilmenite Resources, Iron Mountain Area, Albany County, Wyo. BuMines Inf. Circ. 8037, 1961, 133 pp.

Everett, F. D. Tungsten Deposits of Utah. BuMines Inf. Circ. 8014, 1961, 44 pp.

Farnham, L. L., L. A. Stewart, and C. W. Delong. Manganese Deposits of Eastern Arizona. BuMines Inf. Circ. 7990, 1961, 178 pp.

Stewart, L. A. Mining Methods and Costs, Regal Asbestos Mine, Jaquays Mining Corp., Gila County, Ariz. BuMines Inf. Circ. 7986, 1961, 53 pp.

Van Sant, J. N. Refractory-Clay Deposits of Wyoming. BuMines Rept. of Inv. 5652, 1961, 105 pp.

[3] Becker, R. M., and Scott W. Hazen, Jr. Particle Statistics of Infinite Populations as Applied to Mine Sampling. BuMines Rept. of Inv. 5669, 1961, 79 pp.

Hazen, Scott W., Jr. Statistical Analysis of Sample Data for Estimating Ore. BuMines Rept. of Inv. 5835, 1961, 27 pp.

The Bureau of Mines continued its long-range investigations of coal utilization at Denver. Studies included entrained-state low-temperature carbonization of bituminous coals and lignites, coking properties of selected western coals, static-bed and swept-bed carbonization assays under two pressure conditions, and yields and properties of low-temperature tar. Two reports [4] covering parts of the investigations were published.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of the mineral fuels—carbon dioxide, coal, natural gas, natural gas liquids, peat, and petroleum—was $179.1 million, a slight decrease below that of 1960, and represented 52 percent of the value of all mineral production in Colorado. Gains were recorded in the value of all of the mineral fuels except carbon dioxide and crude petroleum, which declined 5 and 2 percent, respectively.

Asphalt and Related Bitumens.—Gilsonite, mined at Bonanza, Utah, was processed at the American Gilsonite Co. plant near Fruita. Substantial quantities of gasoline, diesel fuel, and metallurgical coke were produced from the gilsonite. The company announced plans for a $300,000 addition to the plant from which 325 barrels a day of liquid petroleum gases (propane with some butane) would be produced. Agreements were made with Tuloma Gas Products Co., a subsidiary of American Oil Co., to market the product in the Grand Junction area.

Considerable attention was directed to the resumption of shale-oil investigation at the Government-owned plant at Rifle. Congressional bills were introduced that would permit reopening the plant and continuing experimental work by private contractors through either the U.S. Department of the Navy or the Department of the Interior. Oil Shale Corp., a New York-based firm with substantial holdings of oil-shale land, continued research through the Denver Research Institute.

Carbon Dioxide.—Natural carbon dioxide production, from wells in Montezuma and Las Animas Counties, increased 8 percent over that of 1960. The gas was processed into dry ice and liquid carbon dioxide at plants in Bent and Montezuma Counties. Carbon dioxide occurring in substantial quantities in oil wells in Jackson County was vented.

Coal (Bituminous).—Total coal production from 85 underground and 6 strip mines increased 2 percent in quantity and 8 percent in value over that of 1960. The gain was attributed to the increasing demand for electric power and to additional quantities of coal used at the steel mills of CF & I at Pueblo and the Columbia-Geneva Steel Division of United States Steel Corp. (U.S. Steel) at its mills in Utah.

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[4] Landers, W. S., J. B. Goodman, and D. J. Donaven. Low-Temperature Carbonization Assays of Coals and Relation of Yields to Analyses. BuMines Rept. of Inv. 5904, 1961, 41 pp.

Landers, W. S., V. F. Parry, Manuel Gomez, E. O. Wagner, J. B. Goodman, and C. R. Nelson. Carbonizing Properties of Wyoming Coals. BuMines Rept. of Inv. 5731, 1961, 74 pp.

TABLE 3.—Coal (bituminous) production, by counties

(Excludes mines producing less than 1,000 short tons)

County	1960		1961	
	Short tons	Average value per ton[1]	Short tons	Average value per ton[1]
Delta	69,893	$5.37	57,137	$5.34
El Paso	[2] 667,106	[2] 7.25	[2] 791,462	[2] 7.35
Fremont	299,027	3.55	308,537	3.59
Garfield	14,798	7.50	16,092	7.00
Gunnison	270,640	5.51	258,766	6.34
Huerfano	60,352	6.36	46,890	6.32
Jackson	169,903	(3)	---	---
La Plata	30,646	4.17	29.518	4.29
Las Animas	697,598	9.25	794,371	9.52
Mesa	107,197	5.46	123,575	5.44
Moffat	(2)	(2)	(2)	(2)
Montrose	(2)	(2)	(2)	(2)
Pitkin	(2)	(2)	(2)	(2)
Rio Blanco	11,106	4.99	10,634	6.21
Routt	467,515	4.03	446,522	3.84
Weld	741,505	4.34	794,442	4.24
Total	3,607,286	5.85	3,677,946	6.20

[1] Value received or charged for coal f.o.b. mine, including selling cost (includes a value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially).

[2] Production of Moffat, Montrose, and Pitkin Counties combined with El Paso County to avoid disclosing individual company confidential data.

[3] Average value of Jackson County concealed to avoid disclosing individual company confidential data.

Public Service Company of Colorado (PSC) planned to construct two 150-megawatt generating stations in the Denver-Boulder area in 1962. These plants, the largest in the Rocky Mountain area when completed, would use coal and natural gas for fuel. Several companies conducted extensive investigations and coal-drilling programs in northwestern Colorado. Private utility companies and associations announced plans for constructing large coal-burning electric-generating plants in the area. The proposed plants would supplement the hydroelectric power being developed by the Colorado River storage project at Flaming Gorge in Utah and Glen Canyon in Arizona. The plants also would provide for an anticipated increase in demand for electric power. Colorado Ute Electric Association, a cooperative, and Western Colorado Power Co., a subsidiary of Utah Power and Light Co., proposed construction of generating plants in the area; initial capacity would be 150 megawatts, with an ultimate capacity of 600 megawatts by 1970.

Natural Gas.—Dry natural gas and oil-well gas were produced in 16 counties. Dry natural gas came from 462 wells in 51 fields. Oil-well gas was processed at natural gas plants for the recovery of natural gasoline, butane, and propane. Natural gas marketed through pipelines was 1 percent greater in quantity and 2 percent less in value than in 1960. Natural gas storage in the abandoned Leyden coal mine northwest of Arvada in Jefferson County by PSC, which was approved by the Colorado Oil and Gas Conservation Commission in September 1960, proved highly successful. Approximately 1 billion cubic feet of gas stored during the summer months was readily available as needed during periods of peak demand. During a record-breaking cold wave in the Denver area in December, withdrawals of 20 to 50 million cubic feet a day were made successfully. The facility assured the Denver area of an adequate supply of natural gas under all climatic conditions. Plans were announced, late in 1961, to extend the Nation's highest natural gas pipeline from Del Norte in Rio Grande County to serve the western slope cities of Saguache, Buena Vista, 2-mile-high Leadville, and the Climax molybdenum mine at Climax. The pipeline would traverse some of the most rugged terrain in the Rocky Mountains and cross the Continental Divide at an altitude of 12,000 feet. The gas would come from the Ignacio field in La Plata County.

Natural Gas Liquids.—Natural gas liquids—natural gasoline, butane, and propane—were recovered at 16 plants in 7 counties. Production was 8 percent above that of 1960, although the value increased only 1 percent because of a sharply reduced unit value for natural gasoline. According to the annual report [5] of the Colorado Oil and Gas Conservation Commission, throughput at the plants, including one compressor plant where no liquids were recovered, was 103.4 billion cubic feet, with the recovery of 4.5 million barrels of liquid products. Residual gas was marketed through pipelines except at the Rangely plant in Rio Blanco County, where it was used for repressuring the Rangely oilfield. Three absorption, five refrigeration, and eight refrigeration-absorption plants were operated.

Peat.—Peat production in Boulder, Gilpin, and Teller Counties was 5 percent greater than in 1960. The entire output was used as a soil conditioner and as an admixture in organic fertilizers.

Petroleum.—Petroleum production from 2,023 wells in 262 fields was 46.7 million barrels, 2 percent below that of 1960. Most of the decline was represented in lower output at the Adena-Adena South field in Morgan County and at the Rangely field in Rio Blanco County. Increased output from other fields and production from new discoveries about equaled declines in older fields. Of the major producing counties, only Washington showed an increased output, compared with that of 1960. At yearend the State was ranked 13th in reserves, with 362 million barrels.

Exploratory and development drilling was at a lower rate than in 1960. Most of the successful exploratory wells were in eastern and southeastern fields. A total of 662 wells (303 exploratory and 359 development) was completed compared with 706 wells (358 exploratory and 348 development) completed in 1960. In 1961 footage drilled was 3.2 million feet compared with 3.5 million feet in 1960. There were 12 oil and 19 gas discoveries compared with 24 oil and 23 gas discoveries in 1960. Major exploratory drilling was done in Washington, Logan, and Morgan Counties in eastern Colorado and in Rio Blanco County in western Colorado. Major development drilling was done in Rio Blanco, Washington, Logan, and Morgan Counties, with the greatest number of completions (76) in Rio Blanco County. Considerable development drilling, primarily for gas, was done in La Plata and Baca Counties.

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[5] Colorado Oil and Gas Conservation Commission. Colorado Oil and Gas Statistics for 1961, Part III, Gasoline and Extraction Plants. 1962, 4 pp.

TABLE 4.—Crude petroleum production, by counties [1]

(Thousand barrels)

County	1960	1961 [2]	Principal fields in 1961 in order of production
Adams	942	909	Badger Creek, Middlemist, Beacon.
Archuleta	103	89	Price Gramps.
Baca	----------	34	Flank.
Bent	8	1	Bent's Fort.
Boulder	2	3	Boulder.
Fremont	27	28	Florence.
Jackson	853	591	McCallum, Battleship, South McCallum.
Kiowa	8	10	Brandon.
La Plata	21	42	Red Mesa.
Larimer	192	187	Fort Collins, Wellington.
Logan	4,583	4,451	Northwest Graylin, Cliff, Lewis Creek, Luft, Yenter.
Moffat	1,822	1,417	Danforth Hills, Moffat, Iles, Buck Peak.
Montezuma	80	107	Flodine Park, Towaoc.
Morgan	9,301	8,947	Adena, Sand River, Bijou, Zorichak, West Bijou.
Prowers	----------	1	Barrel Springs.
Rio Blanco	19,803	19,004	Rangely, Wilson Creek.
Routt	107	145	Sage Creek, Tow Creek.
Washington	8,031	9,285	Plum Bush Creek, Little Beaver, Big Beaver.
Weld	1,584	1,492	Pierce, Black Hollow.
Yuma	2	3	Laird.
Total	47,469	46,746	

[1] Based on Colorado Oil and Gas Conservation Commission county data adjusted to Bureau of Mines total.

[2] Preliminary figures.

TABLE 5.—Wildcat- and development-well completions in 1961, by counties

County	Crude	Gas	Dry	Total	Footage
Wildcat:					
Adams	------	----	13	13	79,000
Archuleta	------	----	1	1	5,700
Baca	1	3	15	19	84,200
Bent	------	----	4	4	19,800
Boulder	------	----	2	2	9,500
Costilla	------	----	2	2	5,900
Delta	------	----	2	2	13,300
Dolores	------	----	1	1	9,500
Eagle	------	----	1	1	4,500
Elbert	------	----	1	1	4,200
Fremont	------	----	1	1	3,500
Garfield	------	3	11	14	57,300
Grand	------	----	2	2	2,900
Gunnison	------	----	1	1	5,100
Huerfano	------	----	1	1	2,000
Jackson	------	----	5	5	19,700
Kit Carson	------	----	1	1	5,200
Larimer	------	----	1	1	100
La Plata	1	----	2	3	9,700
Logan	2	1	33	36	211,000
Mesa	------	4	5	9	44,900
Moffat	------	----	15	15	82,300
Montezuma	1	1	7	9	36,300
Montrose	------	----	2	2	15,000
Morgan	2	2	28	32	185,400
Phillips	------	----	2	2	9,400
Pitkin	------	1	1	2	11,600
Prowers	------	1	5	6	31,500
Rio Blanco	[1] 1	2	23	26	90,900
Routt	------	----	5	5	14,100
San Miguel	1	1	3	5	47,800
Sedgwick	------	----	1	1	3,600
Washington	3	----	63	66	281,500
Weld	------	----	11	11	67,100
Yuma	------	----	1	1	3,900
Total	[1] 12	19	272	303	1,477,400
Development:					
Adams	3	----	12	15	80,100
Archuleta	------	----	3	3	6,800
Baca	------	22	14	36	126,000
Bent	------	----	1	1	4,800
Boulder	------	----	4	4	10,200
Fremont	------	----	3	3	8,700
Garfield	------	3	1	4	20,600
Jackson	2	1	1	4	24,600
Kiowa	------	5	2	7	34,100
La Plata	2	36	11	49	310,800
Larimer	1	----	-----	1	4,600
Logan	13	2	33	48	239,700
Mesa	------	3	2	5	23,400
Moffat	5	3	3	11	59,100
Montezuma	2	----	5	7	17,700
Morgan	[2] 10	1	14	25	147,400
Pitkin	------	----	1	1	5,000
Rio Blanco	23	19	34	76	251,500
San Miguel	------	----	1	1	9,400
Washington	21	----	30	51	247,800
Weld	1	----	5	6	35,600
Yuma	------	----	1	1	5,100
Total	[2] 83	95	181	359	1,673,000
Total all drilling	[3] 95	114	453	662	3,150,400

[1] Condensate-well completion.

[2] Includes 1 condensate-well completion.

[3] Includes 2 condensate-well completions (1 wildcat and 1 development).

Source: Oil and Gas Journal.

TABLE 6.—Oil and gas discoveries in 1961

County and field	Well	Operator	Location			Producing formation	Producing interval (feet)	Total depth (feet)	Initial production		Completion date	Remarks
			Section	Township	Range				Barrels oil per day	Thousand cubic feet gas per day		
Baca County:												
Flank	No. 1 Tevebaugh	Horizon Oil & Gas Co.	7	34 S.	42 W.	Morrow	4, 691–4, 694	5, 131	106		July 26	Pumped.
Playa	No. 1-10 Lepel	do	10	32 S.	44 W.	Topeka	3, 324–3, 332	5, 661		2, 225	Jan. 20	Calculated absolute open flow.
Walsh	No. 1 Burchfield	Keith L. Rising, Trustee; Germany Investment; Wiggins Brothers.	4	32 S.	43 W.	do	3, 245–3, 258	3, 450		2, 500	Feb. 25	Flowed.
Wildcat	No. 1-12 Trahern	Horizon Oil & Gas Co.	12	32 S.	43 W.	do	3, 205–3, 220	3, 250		2, 600	May 25	Do.
Garfield County:												
Wildcat	No. 1 Gross-Hahnewald.	Southern Union Production Co.	8	7 S.	94 W.	Mesaverde	6, 180–7, 394	7, 560		1, 411	Jan. 13	Do.
Do	No. 29-95 Government.	do	29	7 S.	95 W.	do	4, 880–6, 509	6, 509		1, 800	Aug. 17	Flowed—open hole.
Larimer County: Loveland.	No. 1 Trindle	Lakota Petroleum Corp.	30	5 N.	68 W.	Lyons	6, 530–6, 592	6, 621	115		Dec. 21	Pumped—new producing horizon.
Logan County:												
Horn	No. 1 Sindt	Tipps Drilling Co., Inc.	15	11 N.	53 W.	Dakota J	5, 467–5, 473	5, 541	17		Feb. 13	Pumped.
Nabar	No. S-1 Colorado	South Texas Development Co.	32	11 N.	54 W.	do	Notch at 5, 287	5, 419	53		July 21	Do.
Bronco	No. 1 Carey	A. T. Skaer	26	9 N.	53 W.	do	4, 905–4, 909	5, 155	6	1, 449	Aug. 16	Flowed. Old well work over.
Falcon	No. 1 Fehringer	Stuarco Oil Co., Inc.	34	12 N.	52 W.	Dakota D	5, 076–5, 080	5, 264	110		Oct. 13	Pumped.
Seal	No. 1 Budin	Pfeifer Oil & Gas Production Co.	12	8 N.	55 W.	Dakota J	5, 318–5, 320	5, 369	148		May 2	Pumped. Old well work over.
Mesa County:												
Cameo	No. 1 Federal-Colorado-C.	Ambassador Oil Corp.	35	9 S.	99 W.	Dakota	6, 222–6, 235 6, 320–6, 333	7, 009		5, 318	Oct. 2	Flowed.
Fruita	No. 1 Christiana-Government.	The Frontier Refining Co.	9	9 S.	101 W.	Buckhorn	2, 597–2, 603	2, 603		4, 653	Mar. 8	Flowed—open hole.
Wildcat	No. 1 US-Moran	Apache Oil Corp., Petroleum, Inc.	28	10 S.	96 W.	Corcoran	3, 438–3, 492	3, 850		1, 200	Nov. 14	Flowed. Old well drilled deeper. Old total depth to 3,071.
Montezuma County:												
Aztec Wash	No. 9 Ute Mountain	California Oil Co.	8	32 N.	17 W.	Tocito	899– 904	940	2		Nov. 3	Pumped. Old well work over. Old total depth to 1,268. Plugged back to 940.

TABLE 6.—Oil and gas discoveries in 1961—Continued

County and field	Well	Operator	Location			Producing formation	Producing interval (feet)	Total depth (feet)	Initial production		Completion date	Remarks
			Section	Township	Range				Barrels oil per day	Thousand cubic feet gas per day		
Montezuma County—Con.												
Mancos Creek	No. 1 Philmo-Ute	Graridge Corp	16	32 N.	17 W.	Tocito	Notch at 1,265.	2,001	18		Nov. 9	Pumped.
Goodman Point	No. 2 Rowley	Thomas L. Nabers	6	36 N.	18 W.	Paradox	5,666-5,669	5,719	5		Feb. 10	Pumped—new producing horizon. Old well work over. Old total depth to 5,719.
Lebanon Unit	No. 1 Unit	California Oil Co	20	38 N.	15 W.	Cutler	3,200-3,214	7,930		450	Mar. 1	Flowed.
Morgan County:												
Cactus	No. 1 Whittington	W. H. Young	2	5 N.	58 W.	Dakota J	6,013-6,018	6,185	94		Jan. 15	Pumped. Old well work over.
Rio	No. 22-2 Dunne	Forest Oil Corp	22	4 N.	58 W.	Dakota D	5,764-5,775	5,871	480		May 27	Flowed.
Strike	No. 1 Cooke-Longel	W. H. Young	27	5 N.	60 W.	do	6,204-6,209	6,350	12		Feb. 16	Flowed. Old well work over. Old total depth to 6,320.
Forge	No. 1-C Doheny-Schroeder.	Dow & McHugh Oil Co., H.L.M. Drilling Co.	7	2 N.	57 W.	do	5,491-5,496	5,620	120		Dec. 30	Pumped. Old well work over.
Wildcat	No. 25 Huey	H. L. Hunt	26	2 N.	56 W.	Dakota J	5,117-5,123	5,170	2	580	Aug. 10	Flowed.
Pitkin County: Wolf Creek Unit.	No. 1 Cal	Utex Exploration Co	26	8 S.	90 W.	Cozette	4,658-4,708 4,774-4,786	5,165		3,380	Jan. 4	Do.
Prowers County: Wildcat.	No. 1 Kern	Frankfort Oil Co	5	23 S.	47 W.	Morrow	Slot at 4,553.	4,801		375	Mar. 10	Do.
Rio Blanco County: Piceance Creek.	No. 68-11 Piceance Creek Unit.	Mobil Oil Co	11	2 S.	97 W.	Wasatch	5,185-5,270	7,751	15	5,150	Sept. 20	Flowed—new producing horizon.
Washington County:												
Jack Rabbit	No. 2 Kalous	Kimbark Exploration Co.	29	2 S.	56 W.	Dakota J	5,189-5,190	5,335	63		July 21	Pumped. Old well drilled deeper. Old total depth to 5,318.
Pitch	No. 1 Downing	Tipps Drilling Co., Inc.	20	3 S.	53 W.	do	4,708-4,713	4,777	50		Jan. 25	Pumped.
Tarn	No. 1 Challis Farms, Inc.	Plains Exploration Co.	31	1 N.	53 W.	Dakota D	4,886-4,892	5,451	26		July 30	Do.
Rush-Willadel	No. 1 Jones	Union Texas Natural Gas Corp.	26	3 S.	51 W.	Dakota J	3,938-3,944	4,042	166		Aug. 1	Pumped—new producing horizon.
Weld County: Wildcat.	No. 1 Thomas	DeVaughn Oil & Gas Co.	31	7 N.	58 W.	Dakota D	6,459-6,463	6,570	24	200	Feb. 19	Flowed. Old well work over.

Source: Colorado Oil and Gas Conservation Commission. Petroleum Information, 1961 Resume, Oil and Gas Operations in the Rocky Mountain Region.

METALS

Beryllium.—Beryllium-concentrate (beryl) production, from mines in Chaffee, Fremont, Larimer, and Park Counties, was more than double that of 1960. The value, however, increased only moderately because the average grade of beryllium oxide was 3.51 percent compared with 5.66 percent in 1960. Most of the output was from the Boomer lode in Park County. Sales were made to the GSA buying station at Custer, S. Dak., and to Mineral Concentrates and Chemical Co., Inc., (Mincon), for processing at its plant at Loveland, where high-quality beryllium chemical compounds were prepared.

Cadmium.—Cadmium was recovered as metal and as compounds from flue dust, dross, and similar byproducts from other smelters and processing plants by the American Smelting and Refining Co. (Asarco) at its Globe plant in Denver. Because the State or country of origin could not be determined, the value of the refined products was not included in the State total of mineral value.

Copper.—Copper production from mines in 14 counties increased 28 percent in quantity and 19 percent in value over that of 1960. The average value per pound was $0.300 compared with $0.321 in 1960. Production from the Idarado mine operated by Idarado Mining Co., in Ouray and San Miguel Counties; the Eagle mine operated by The New Jersey Zinc Co., in Eagle County; the Camp Bird mine operated by Camp Bird Colorado, Inc., in Ouray County; and the Emperius mine operated by Emperius Mining Co., in Mineral County, represented 99 percent of total production in the State.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1952-56 (average)	131	18	1,158	105,241	$3,683	2,698	$2,441
1957	115	16	1,111	87,928	3,078	2,788	2,523
1958	91	17	869	79,539	2,784	2,056	1,860
1959	65	16	769	61,097	2,138	1,341	1,213
1960	70	15	809	61,269	2,144	1,659	1,502
1961	57	19	938	67,515	2,363	1,965	1,817
1858-1961	------------	------------	(3)	40,614,086	915,370	768,466	602,036

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	3.924	$2,584	21,061	$6,242	40.352	$10.735	$25.685
1957	5,115	3,079	21.003	6,007	47,000	10,904	25,591
1958	4,193	2,206	14,112	3,302	37.132	7,575	17,727
1959	2,940	1.805	12.907	2,969	35,388	8,139	16,264
1960	3,247	2,085	18,080	4,231	31,278	8.070	18,032
1961	4,141	2,485	17,755	3.658	42,647	9,809	20,132
1858-1961	303,172	96,574	2,779,078	330,947	1,967,503	367,933	2,312,859

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore, old slag, or tailings shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed.

[3] Data not available.

Minor producers were the Rico Argentine mine operated by Rico Argentine Mining Co., in Dolores County, and the Shenandoah mine operated by Standards Metals Corp., in San Juan County. A small quantity was recovered from the cleanup at the abandoned Arkansas Valley smelter at Leadville.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing [1]		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Adams	------	6	------	1,115	$39,025	152	$141
Arapahoe	------	1	------	1	35	------	------
Boulder	2	------	66	17	595	799	739
Clear Creek	6	------	3,113	123	4,305	13,735	12,698
Dolores	1	------	14,000	63	2,205	49,091	45,384
Eagle	1	1	297,705	6,115	214,025	672,906	622,095
Gilpin	2	4	14,664	539	18,865	1,890	1,747
Gunnison	3	------	106	73	2,555	61	56
Hinsdale	1	------	700	81	2,835	205	190
Jefferson	------	4	------	563	19,705	90	83
Lake	1	------	1,273	539	18,865	21,627	19,994
La Plata	2	------	104	205	7,175	273	252
Mineral	1	------	41,657	624	21,840	303,995	281,040
Moffat	------	2	------	12	420	------	------
Montezuma	------	------	3	6	210	1	1
Ouray	4	------	276,482	16,569	579,915	482,792	446,336
Park	2	------	220	98	3,430	726	671
Pitkin	1	------	110	------	------	764	706
San Juan	12	------	2,531	221	7,735	5,740	5,307
San Miguel	3	------	243,970	14,414	504,490	404,150	373,633
Summit	3	1	826	64	2,240	3,446	3,186
Teller	12	------	40,710	26,073	912,555	2,578	2,383
Total:							
1961	57	19	938,240	67,515	2,363,025	1,965,021	1,816,642
1960	70	15	808,744	61,269	2,144,415	1,659,037	1,501,512

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Adams	------	------	------	------	------	------	$39,166
Arapahoe	------	------	------	------	------	------	35
Boulder	(3)	$30	(3)	$21	------	------	1,385
Clear Creek	2	1,080	43	8,806	7	$1,656	28,545
Dolores	7	4,290	833	171,444	947	217,695	441,018
Eagle	668	400,890	4,213	867,909	24,627	5,664,313	7,769,232
Gilpin	2	1,470	17	3,399	28	6,417	31,898
Gunnison	------	------	(3)	41	(3)	46	2,698
Hinsdale	------	------	------	------	(3)	12	3,037
Jefferson	------	------	------	------	------	------	19,788
Lake	17	10,260	157	32,455	27	6,176	87,750
La Plata	1	570	(3)	41	(3)	12	8,050
Mineral	275	164,850	1,884	388,083	2,371	545,353	1,401,166
Moffat	------	------	------	------	------	------	420
Montezuma	------	------	------	------	------	------	211
Ouray	1,548	928,800	5,545	1,142,322	7,391	1,699,884	4,797,257
Park	1	660	3	659	1	207	5,627
Pitkin	(3)	300	15	3,111	5	1,184	5,301
San Juan	16	9,360	40	8,219	22	5,060	35,681
San Miguel	1,602	961,050	4,895	1,008,350	7,101	1,633,138	4,480,661
Summit	2	990	110	22,670	120	27,657	56,743
Teller	------	------	------	------	------	------	914,938
Total:							
1961	4,141	2,484,600	17,755	3,657,530	42,647	9,808,810	20,130,607
1960	3,247	2,084,574	18,080	4,230,720	31,278	8,069,724	18,030,945

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines.
[2] Does not include gravel washed.
[3] Less than 0.5 ton.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	21	56,248	26,709	4,576	4,900	33,200	56,400
Dry gold-silver	1	2,000	84	1,918	1,100	30,400	6,700
Dry silver	4	373	4	11,586	800	13,800	7,700
Total	26	58,621	26,797	18,080	6,800	77,400	70,800
Copper	5	15,764	5,232	397,342	956,700	57,700	2,700
Copper-lead-zinc	6	522,397	31,075	890,849	6,315,100	20,932,100	29,008,900
Copper-zinc	1	22		41	1,700		1,800
Lead	6	1,026	45	2,242	1,900	51,900	
Lead-zinc	12	338,975	1,638	634,351	965,200	14,074,500	56,153,900
Zinc	1	18	78	135	400	700	2,100
Total	29	878,202	38,068	1,924,960	8,241,000	35,116,900	85,169,400
Other "lode" material:							
Gold cleanings and mill cleanings	(2)	70	187	13		100	
Gold tailings	2	100	14	72		500	100
Lead smelter cleanup	(2)	1,247	525	21,627	34,200	315,100	53,700
Total	2	1,417	726	21,712	34,200	315,700	53,800
Total "lode" material	57	938,240	65,591	1,964,752	8,282,000	35,510,000	85,294,000
Gravel (placer operations)	19		1,924	269			
Total all sources	76	938,240	67,515	1,965,021	8,282,000	35,510,000	85,294,000

[1] Detail will not necessarily add to totals because some mines produced more than one class of material.
[2] From properties not classed as mines.

Gold.—Gold produced at placer and lode mines in 21 counties was 10 percent above that of 1960. Gold from placer operations was from 19 mines in 8 counties, the major portion recovered in connection with sand and gravel production. Gold was recovered by installing sluice boxes in the sand and gravel washing plants in Adams, Arapahoe, and Jefferson Counties. The other placer operations, on stream and bench gravels and old tailings in Eagle, Gilpin, Moffat, Park, and Summit Counties, yielded relatively little gold. Gold from lode mines was produced at 47 mines in 17 counties, much of it as a byproduct in producing copper, lead, and zinc. Teller County led in gold production, from 12 mines in the *Cripple Creek* mining district. Of the total gold production, 59 percent was recovered as a byproduct in mining complex ores of copper, lead, and zinc, principally in Ouray, San Miguel, and Eagle Counties.

Iron ore.—Iron-ore production was more than double that of 1960. Expanded output by Pitkin Iron Corp. at its Cooper Fork deposit above Ashcroft in Pitkin County accounted for this gain. The entire production was shipped to CF&I for use in its blast furnaces at Pueblo. Brown ore or limonite mined from surface deposits in San Juan and San Miguel Counties was used in manufacturing paint pigments. Most of the iron ore used by CF&I at its Pueblo plant was from company-owned mines in Wyoming and Utah.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in 1961, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	4,291	1,399			
Cleanings	8	4			
Total	4,299	1,403			
Cyanidation:					
Ore	25,989	2,715			
Cleanings	163	2			
Total	26,152	2,717			
Total recoverable in bullion	30,451	4,120			
Concentration, and smelting of concentrates:					
Ore	29,245	1,534,109	7,297,200	35,109,000	85,218,800
Old tailings	11	71		500	100
Total	29,256	1,534,180	7,297,200	35,109,500	85,218,900
Direct-smelting:					
Ore	5,340	404,817	950,600	85,300	21,400
Cleanings	541	21,634	34,200	315,200	53,700
Old tailings	3	1			
Total	5,884	426,452	984,800	400,500	75,100
Placer	1,924	269			
Grand total	67,515	1,965,021	8,282,000	35,510,000	85,294,000

Lead.—Lead production, from ores of copper, lead, and zinc in 15 counties, declined 2 percent in quantity and 14 percent in value compared with that of 1960. The weighted-average price of refined lead was $0.103 compared with $0.117 in 1960. Major production was from Ouray, San Miguel, Eagle, Mineral, and Dolores Counties. The Idarado mine was the major producer; other important producing mines were the Eagle, Camp Bird, Emperius, and Rico Argentine. A substantial quantity was recovered from the cleanup of the dismantled Arkansas Valley smelter at Leadville. Production began at the Wellington mine operated by Parnett Consolidated Corp. in Summit County.

Molybdenum.—Production of molybdenum ore at the Climax mine in Lake County by Climax Molybdenum Co., Climax Division, American Metal Climax, Inc., increased 5 percent over that of 1960. The quantity of molybdenum recovered declined 3 percent because lower grade ores were withdrawn from the stopes to maintain maximum draw control of broken ore and to assure a maximum future recovery. The annual report of the corporation showed that 12,274,000 tons of ore was mined with the recovery of 48,074,000 pounds of molybdenum compared with 11,684,000 tons of ore mined with a recovery of 49,631,000 pounds of molybdenum in 1960. Byproduct pyrite, tungsten, and tin also were recovered from the molybdenum ore.

Silver.—Most of the silver production in 1961 was from mines producing substantial quantities of copper, lead, and/or zinc. Production of silver was reported from 44 lode mines in 18 counties and from 15 placer operations in 4 counties. Of the total produced, 95 percent was from four mines—one each in Eagle, Mineral, Ouray, and San Miguel Counties. Silver recovered increased 18 percent in quantity and 21 percent in value over that of 1960. Previously, the value of silver was based on the Treasury buying price of $0.9050505 an ounce; however, because of termination of sales to industry by the Treasury in November and the subsequent rise in price, the value for 1961 was based on the weighted-average price on the New York market, or $0.92449 an ounce.

Thallium.—Thallium was recovered as metal and as compounds from flue dust, dross, and similar byproducts from other smelters and processing plants by Asarco at its Globe plant in Denver. Because the State or country of origin could not be determined, the value of the refined products was not included in the State total of mineral value.

Tin.—Tin was recovered by Climax Molybdenum Co. from flotation tailing at its Climax molybdenum mine at Climax.

Tungsten.—Tungsten recovered by Climax Molybdenum Co. from flotation tailing at its Climax molybdenum mine at Climax was more than double that of 1960. However, the value of output increased only 90 percent because of weakening of the world tungsten market in the latter part of 1961.

Uranium.—Production of uranium ore, from 13 counties, was 12 percent more than in 1960; however, because of a decrease in the grade of ore mined, from 0.25 percent uranium oxide to 0.22 percent, the mine value declined 8 percent. At some mines, reserves of higher grade ore were becoming exhausted and only lower grade material remained. The number of operations remained the same as in 1960,

TABLE 11.—Mine production of uranium ore, by counties [1]

County	1960				1961			
	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]
Boulder	2	4,131	52,181	$238,088	1	11,436	82,085	$356,803
Clear Creek	1	6	12	24	1	6	14	35
Fremont	16	23,995	112,086	454,272	16	29,984	128,466	502,862
Gilpin	1	(3)	(3)	(3)	--------	--------	--------	--------
Gunnison	1	126	896	3,931	--------	--------	--------	--------
Hinsdale	--------	--------	--------	--------	1	(3)	(3)	(3)
Jackson	1	(3)	(3)	(3)	--------	--------	--------	--------
Jefferson	10	24,732	323,380	1,489,648	6	28,027	328,439	1,492,469
Las Animas	1	(3)	(3)	(3)	--------	--------	--------	--------
Mesa	80	120,438	723,380	3,054,964	74	98,521	595,241	2,533,019
Moffat	17	(3)	(3)	(3)	16	(3)	(3)	(3)
Montezuma	1	12	46	173	--------	--------	--------	--------
Montrose	285	509,338	2,595,272	10,710,253	299	538,698	2,751,661	11,396,284
Park	1	(3)	(3)	(3)	--------	--------	--------	--------
Pitkin	1	37	88	213	--------	--------	--------	--------
Pueblo	2	(3)	(3)	(3)	1	(3)	(3)	(3)
Rio Blanco	11	3,804	17,098	69,481	7	1,946	8,676	34,163
Saguache	6	172,468	534,349	1,621,188	6	126,825	426,267	1,387,009
San Miguel	85	182,776	894,968	3,686,954	94	142,161	686,840	2,815,909
Teller	--------	--------	--------	--------	1	8	29	104
Undistributed	--------	107,720	517,240	2,133,111	--------	304,850	532,217	990,024
Total	522	1,149,583	5,770,996	23,462,300	523	1,282,462	5,539,935	21,508,681

[1] Based on data supplied to the Bureau of Mines by the AEC.

[2] F.o.b. mine value; base price, grade premiums, and exploration allowance.

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

although some were abandoned and others started. Purchase contracts between the Atomic Energy Commission (AEC) and three operators were revised to adjust 1961 production to anticipated demands and to provide for continuous operation through 1966 or until the quantity of concentrate specified in the contract had been delivered, whichever occurred first. Revised contracts, in all instances, provided for processing a specified quantity of ore from independent operators. Revised contracts were completed and approved in March with Trace Elements Corp., a unit of Union Carbide Nuclear Co. Division, Union Carbide Corp.; and in May with Vanadium Corporation of America (VCA) and with Union Carbide Nuclear Co. Division, Union Carbide Corp., for its mills at Rifle and Uravan.

Vanadium.—Vanadium was recovered from uranium ores that contained significant quantities of vanadium and that were processed at plants equipped with vanadium-recovery units. Vanadium was recovered at uranium ore processing mills in Durango, Grand Junction, Rifle, Shiprock (N. Mex.), and Uravan. The quantity recovered was 3 percent above that of 1960. From stockpiles at the mills, AEC sold in excess of 1 million pounds of vanadium pentoxide to private firms, Union Carbide Metals Co., VCA, and Derby & Co., Ltd. The successful bids ranged from $0.985 to $1.120 per pound.

Zinc.—Zinc production from complex ores of copper, lead, and zinc in 15 counties increased 36 percent in quantity and 22 percent in value over that of 1960. Over 99 percent of the output was from five operations—Eagle, Idarado, Camp Bird, Emperius, and Rico Argentine. The average weighted price for zinc was $0.115 compared with $0.129 in 1960.

NONMETALS

Cement.—Production of portland and masonry cements, at plants in Fremont and Larimer Counties, rose 6 percent in quantity and value over that of 1960. Limestone and sandstone used at the plants were mined from nearby quarries. Portland cement clinker was used as a base for manufacturing masonry cement at both plants. Most of the cement output was used in Colorado; however, substantial shipments were made to consumers in Kansas, Montana, Nebraska, New Mexico, Utah, and Wyoming.

Clays.—Bentonite, fire clay, and miscellaneous clay, produced in 11 counties, increased 13 percent in quantity but declined 13 percent in value compared with that of 1960. Fire clay production declined 33 percent, whereas miscellaneous clay production increased 82 percent, thus accounting for the drop in total value because of the relatively lower unit value of miscellaneous clay. Twenty-nine percent of the fire clay was used for refractories; the remainder was used for building brick, sewer and draintile, and similar heavy clay products. Fire clay from Pueblo County was used almost exclusively in manufacturing refractory clay products, whereas the fire clay from deposits in Jefferson County mostly was used for building brick. The marked increase in production of miscellaneous clay was largely because of its use in manufacturing lightweight aggregate at a plant that began operations in August.

TABLE 12.—Clay production, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Arapahoe	------------	------------	2,400	$3,600
Boulder	(1)	(1)	(1)	(1)
Custer	2,082	$7,513	1,575	5,355
Douglas	78,140	196,083	71,375	181,505
El Paso	10,833	42,868	(1)	(1)
Fremont	23,671	105,417	16,611	61,174
Huerfano	3,720	(1)	4,215	(1)
Jefferson	212,843	607,152	365,001	647,619
Las Animas	8,685	19,975	9,372	28,116
Mesa	(1)	(1)	(1)	(1)
Pueblo	64,738	266,465	(1)	(1)
Undistributed	85,050	178,766	85,528	313,677
Total	489,762	1,424,239	556,077	1,241,046

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Feldspar.—Feldspar production, from three counties, was less than in 1960. Major production was by M. & S., Inc., at the Homestake mine in Chaffee County. The output was ground at the Western Feldspar Milling Co. plant in Chaffee County and shipped to glass plants in Illinois, Oklahoma, and Texas.

Fluorspar.—Production of fluorspar, in Boulder and Jackson Counties, was 12 percent below that of 1960. Major production was by General Chemical Division, Allied Chemical Corp., at its Burlington mine in Boulder County. Crude material was milled to produce acid-grade fluorspar used by the company in manufacturing hydrofluoric acid.

Gem Stones.—Gem stones, gem material, and mineral specimens were collected by individuals, gem societies, and operators of gem shops in widely distributed areas in the State. A wide variety of minerals and gems—including agate, jasper, beryl, and quartz—and numerous fossil specimens were collected. Chaffee, Mineral, Ouray, Park, Saguache, and San Juan Counties accounted for 38 percent of the total value. Production was valued at $36,000, a decline of 20 percent compared with that of 1960.

Gypsum.—Gypsum production, from four mines in Fremont and Larimer Counties, was 85,000 tons, a gain of 4 percent compared with that of 1960. The output was calcined for manufacturing wallboard and was used as a portland-cement retarder and as a soil conditioner.

Lime.—Recorded lime production of 75,000 tons was many times that of 1960. The data, however, are not comparable because in 1961 lime production by sugar companies for use in refining sugar from sugar beets was included for the first time. Quicklime was produced by 4 sugar companies in 10 counties for use at 12 plants. Commercial production of lime at plants in El Paso and Garfield Counties was used in the building, chemical, and other industries.

Mica.—Scrap mica output, all produced by Jolex Mica Co., Inc., at its Langston mine in Larimer County, was 600 tons, an increase of 76 percent over the total production in 1960 that came from two mines. The entire output, ground at the company plant at Fort Collins, was used in well drilling.

Perlite.—Production of crude perlite at the Rosita mine of Persolite Products, Inc., was 77 percent more than in 1960. The entire output was processed at the Persolite plant at Florence. Crude perlite from deposits in New Mexico was processed at the Western Mineral Products Co. plant at Denver for use in building plaster and fireproofing material. Great Lakes Carbon Corp. completed a processing plant at Antonito in Conejos County. Crude material came from the company-owned mine at No Agua, N. Mex., 23 miles south of Antonito. The plant produced a filter aid used extensively in many industries. Products from the plants at Florence and Antonito also were used in building plaster, loose-fill insulation, lightweight aggregate, oil-well cement, and soil conditioner.

Pumice.—Pumice and pumicite production, from deposits of scoria in Costilla and Routt Counties and volcanic cinder in Eagle County, was 38 percent above that of 1960. Crude material was sized and graded and used as lightweight aggregate, roofing material and insulation, and in highway construction.

Pyrites.—Pyrite was produced in two counties for use in manufacturing sulfuric acid; output was 28 percent below that of 1960. Major pyrite production, by Rico Argentine Mining Co. at its Rico Argentine mine in Dolores County, was used in manufacturing sulfuric acid in a company-owned plant at the mine. Pyrite recovered as a byproduct at the Climax molybdenum mine in Lake County by Climax Molybdenum Co. was used for manufacturing sulfuric acid by General Chemical at its Denver plant. A small quantity of pyrite mined by S. N. N. Mining Co., Inc., at its property in Custer County was shipped out of the State.

Salt.—Union Carbide Nuclear Co. recovered salt from brines pumped from a well in Montrose County. The salt was used in processing uranium ores at company-owned plants at Rifle and Uravan.

Sand and Gravel.—Sand and gravel was produced in 59 of the State's 63 counties. Output was 4 percent below that of 1960. The sustained high rate of production reflected the continued building boom in urban and suburban areas and the highway construction by and through Federal, State, and county agencies.

Of the total production, 51 percent was by 88 commercial operators in 33 counties. Building and road construction each absorbed 48 percent of the total commercial production; the remaining 4 percent was for blast, engine, filtration, and foundry sand; railroad ballast; fill; and other uses.

TABLE 13.—Sand and gravel production in 1961, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	3,330	$3,391	La Plata	304	$261
Alamosa	217	98	Larimer	457	630
Arapahoe	1,683	1,924	Las Animas	265	324
Archuleta	148	104	Lincoln	175	110
Baca	143	135	Logan	218	135
Bent	44	26	Mesa	987	897
Boulder	535	467	Mineral	18	19
Chaffee	96	101	Moffat	138	109
Cheyenne	20	10	Montezuma	(1)	(1)
Clear Creek	70	77	Montrose	294	149
Conejos	71	43	Morgan	195	179
Costilla	19	19	Otero	154	102
Crowley	21	11	Ouray	2	1
Custer	82	49	Phillips	37	18
Delta	232	231	Pitkin	38	43
Dolores	219	231	Prowers	199	245
Douglas	562	489	Pueblo	571	508
Eagle	69	60	Rio Blanco	3	7
Elbert	27	21	Routt	198	254
El Paso	1,113	975	Saguache	5	8
Fremont	46	72	San Juan	2	1
Garfield	10	9	San Miguel	125	79
Gilpin	3	3	Sedgwick	130	105
Grand	232	156	Summit	314	266
Gunnison	2	2	Teller	5	3
Huerfano	9	7	Washington	330	216
Jackson	222	170	Weld	1,101	623
Jefferson	1,985	1,828	Yuma	220	215
Kiowa	189	136	Undistributed	375	493
Kit Carson	14	7			
Lake	87	94	Total	18,360	16,946

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Government-and-contractor production was by 168 operators in 57 counties; 65 percent was by contractors, and the remaining 35 percent by State, county, and municipal crews. Road construction accounted for 95 percent of the Government-and-contractor production; building, 1 percent; fill and other uses, 4 percent. The trend toward washing, sizing, or otherwise preparing material to meet more rigid specifications continued, with 86 percent of the commercial production and 80 percent of the Government-and-contractor output receiving some treatment. Prices ranged from a low of $0.39 per ton for fill sand to a high of $10.37 per ton for carefully prepared filter sand. For the major uses, building sand and gravel was valued at an average of $1.22 per ton, and paving sand and gravel at an average of $0.82 per ton.

Progress continued in constructing the National System of Defense Highways as well as in State, county, and municipal construction. During the year, 44 miles of the National System was completed to full standards and 5.7 miles was completed to standards adequate for current traffic. At yearend, 278.4 miles of the system was open to traffic, 39.4 miles was under construction, and engineering and right-of-way acquisition had begun on 142 miles. In the State 488.2 miles of the 948 miles designated as part of the system remained to be planned and built.

TABLE 14.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Construction sand:				
Building	1,725	$2,026	1,645	$1,827
Paving	860	742	447	319
Railroad ballast	(1)	(1)	----------	----------
Fill	50	37	12	5
Other	70	168	28	30
Industrial sand:				
Blast	1	8	(1)	(1)
Engine	(1)	(1)	(1)	(1)
Filtration	2	21	5	54
Other	16	50	16	49
Ground sand: Foundry	8	11	13	15
Total sand	2,732	3,063	2,166	2,299
Construction gravel:				
Building	2,180	2,623	2,886	3,699
Paving	5,041	4,686	4,041	3,393
Railroad ballast	----------	----------	2	5
Fill	104	75	138	86
Other	96	249	57	126
Miscellaneous gravel	140	191	93	112
Total gravel	7,561	7,824	7,217	7,421
Total sand and gravel	10,293	10,887	9,383	9,720
Government-and-contractor operations:				
Sand:				
Building	2	7	25	40
Paving	811	637	122	104
Fill	----------	----------	8	4
Other	----------	----------	5	5
Total sand	813	644	160	153
Gravel:				
Building	196	149	88	90
Paving	7,715	5,166	8,420	6,842
Fill	36	36	309	141
Total gravel	7,947	5,351	8,817	7,073
Total sand and gravel	8,760	5,995	8,977	7,226
All operations:				
Sand	3,545	3,707	2,326	2,452
Gravel	15,508	13,175	16,034	14,494
Grand total	19,053	16,882	18,360	16,946

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

Stone.—Stone production increased slightly over that of 1960. The variety of stone products mined at Colorado quarries included crushed granite, limestone, sandstone, and miscellaneous stone for road construction, riprap, concrete aggregate, and other purposes; and cut stone (granite, marble, and sandstone) for building and ornamental uses. Crushed limestone, representing 91 percent of the total output of stone, was used principally for flux, road construction, and concrete aggregate; in filters; for manufacturing lime used for building purposes and refining sugar; and for manufacturing portland and masonry cements. The greatest output of dimension stone was from the Lyons sandstone of Permian age, which cropped out extensively in Boulder and Larimer Counties and was a nearly pure red-to-pink quartzose sandstone. The thin lamellar structure of the stone permitted easy separation and cutting to specific dimensions. The stone was widely used for flagging, building facing, and similar purposes. Many of the buildings at the State University at Boulder as well as other public and private buildings, are faced with Lyons sandstone.

Vermiculite.—Crude vermiculite from deposits in Montana was exfoliated by Western Mineral Products Co. at its plant in Denver. The primary use of the processed material was as an aggregate in acoustical plaster and for loose-fill insulation.

TABLE 15.—Stone production in 1961, by counties

County	Short tons	Value	County	Short tons	Value
Adams	7,915	$28,165	Las Animas	486	$1,716
Alamosa	702	4,911	Logan	8,536	6,402
Arapahoe	4,046	18,908	Mesa	50	125
Archuleta	2,739	11,656	Moffat	59,881	106,932
Boulder	8,482	78,108	Montezuma	58	290
Chaffee	286,876	695,957	Montrose	2,300	9,200
Clear Creek	3,509	8,098	Morgan	1,845	6,510
Custer	1,239	12,390	Otero	10,443	20,219
Delta	10	200	Park	884	9,724
Dolores	411	3,826	Pueblo	42	112
Douglas	702	3,201	Rio Blanco	1,483	2,966
El Paso	(1)	(1)	Routt	825	6,600
Fremont	943,498	1,845,675	Saguache	41	835
Garfield	(1)	(1)	San Miguel	2,600	10.400
Grand	3,038	14,607	Summit	576	1,356
Gunnison	(1)	(1)	Teller	4,362	47,966
Huerfano	486	1,716	Washington	1,026	6,157
Jackson	544	1,922	Weld	13,248	21,409
Jefferson	12,190	61,215	Undistributed	199,733	498,246
Lake	(1)	(1)			
La Plata	170	1,000	Total	2,451,290	5,300,564
Larimer	866,314	1,751,844			

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

TABLE 16.—Stone sold or used by producers, by kinds

Year	Granite		Basalt and related rocks (traprock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1957	18,367	$111,425	3,500	$65,000	679	$28,782	2,290,500	$3,238,900
1958	10,837	82,060	----------	----------	2,058	186,012	2,701,750	4,004,500
1959	136,439	229,460	(1)	(1)	(1)	(1)	2,482,700	4,344,000
1960	145,944	532,041	16,400	25,700	4,075	124,026	2,123,104	3,484,757
1961	10,528	145,988	----------	----------	9,350	75,171	2,221,902	4,255,761

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1957	121,619	$721,595	3,800	$2,600	2,438,465	$4,168,302
1958	37,641	342,412	177,984	328,063	2,930,270	4,943,047
1959	43,381	294,015	161,149	669,043	2,823,669	5,536,518
1960	61,371	298,447	90,952	185,809	2,441,936	4,650,780
1961	52,281	427,356	157,229	396,288	2,451,290	5,300,564

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other stone."

TABLE 17.—Stone sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble……short tons..	4,095	$70,510	7,095	$106,033
Rough architectural……cubic feet..	46,500	87,582	80,439	86,886
Approximate equivalent in short tons……	3,647	-----	6,613	-----
Dressed architectural……cubic feet..	5,429	21,891	-----	-----
Approximate equivalent in short tons……	429	-----	-----	-----
Rough monumental……cubic feet..	11,045	35,485	8,852	21,531
Approximate equivalent in short tons……	953	-----	740	-----
Dressed monumental……cubic feet..	4,656	101,400	11,908	114,784
Approximate equivalent in short tons……	414	-----	977	-----
Flagging……cubic feet..	33,690	39,374	44,971	38,078
Approximate equivalent in short tons……	2,628	-----	3,516	-----
Total dimension stone (approximate) short tons..	12,166	356,242	18,941	367,312
Crushed and broken stone:				
Riprap……short tons..	31,075	58,319	29,819	92,308
Metallurgical……do....	335,704	710,682	476,293	1,037,718
Concrete and roadstone……do....	515,826	735,726	272,984	571,271
Chemical……do....	50,181	119,676	(1)	(1)
Miscellaneous……do....	[2] 1,496,984	[2] 2,670,135	[3] 1,653,253	[3] 3,231,955
Total crushed and broken stone……do....	2,429,770	4,294,538	2,432,349	4,933,252
Grand total (approximate)……do....	2,441,936	4,650,780	2,451,290	5,300,564

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Miscellaneous."

[2] Includes agriculture, asphalt filler, chemicals, cement, lime, marble whiting, ornamental aggregate, plaster sand, poultry grits, roofing chips, stucco, and terrazzo.

[3] Includes agriculture, cement, chemicals, coal dust, driveways, erosion control, feed supplement, filler (asphalt, rubber, and other), landscaping, lime, marble whiting, marker, ornamental aggregate, plaster sand, poultry grits, roofing chips, stucco, terrazzo, and walks.

REVIEW BY COUNTIES

Only those counties with significant production or mineral industry activity are discussed below; see table 18 for additional details.

Adams.—Sand and gravel and petroleum output accounted for 98 percent of the total value of mineral production in the county. Sand and gravel produced at 12 commercial and 9 Government-and-contractor operations was 3.3 million tons. Leading producers were Brannan Sand & Gravel Co., Boise Cascade Sand & Gravel Co., Western Paving Construction Co., and Cooley Gravel Co. Pits in Adams County yielded 18 percent of all sand and gravel produced in the State. Six operators recovered gold and silver at washing plants as a byproduct of sand and gravel operations. Contractors produced crushed stone for the Colorado Department of Highways. The Great Western Sugar Co. produced quicklime for use in processing sugar beets.

Petroleum production, from 81 wells in 21 fields, was slightly below that of 1960. Oil-well gas output was processed at the N. C. Ginther plant at the Leader field. Throughput was 281 million cubic feet of gas, with the recovery of 16,000 barrels of natural gas liquids. A petroleum refinery at Derby operated throughout the year.

Alamosa.—Oriental Refining Co. operated its 1,100-barrel-a-day refinery at Alamosa. Throughput was 279,000 barrels of crude oil, a 2-percent increase over that of 1960. The county highway department construction and maintenance crews and a contractor for the State highway department produced sand and gravel for road construction.

TABLE 18.—Value of mineral production in Colorado, by counties [1]

County	1960	1961 [2]	Minerals produced in 1961 in order of value
Adams [8]	[4] $6,330,996	[5] $6,125,831	Sand and gravel, petroleum, lime, gold, stone, silver.
Alamosa	6,500	102,811	Sand and gravel. stone.
Arapahoe	1,417,700	1,946,843	Sand and gravel, stone, clays, gem stones, gold.
Archuleta	[4] 308,000	372,366	Petroleum, sand and gravel, stone, gem stones.
Baca [5]	61,338	232,900	Sand and gravel, petroleum.
Bent [5]	114,033	28,805	Sand and gravel, petroleum, gem stones.
Boulder	1,805,373	[6] 1,916,536	Flourspar, sand and gravel, uranium ore, lime, stone, clays, peat, petroleum, silver, gold, copper, lead.
Chaffee	606,838	893,989	Stone, sand and gravel, feldspar, gem stones, beryllium concentrate.
Cheyenne	141,800	9,800	Sand and gravel.
Clear Creek	240,291	114,078	Sand and gravel, silver, lead, stone, gold, zinc, copper, uranium ore.
Conejos	2,650	43,400	Sand and gravel.
Costilla	(7)	(7)	Pumice, sand and gravel.
Crowley	91,800	30,600	Lime, sand and gravel.
Custer	(7)	117,631	Sand and gravel, perlite, stone, pyrites, clays.
Delta	641,801	(7)	Coal, sand and gravel, lime, stone.
Dolores	(7)	(7)	Sand and gravel, zinc, lead, pyrites, silver, copper, stone, gold, gem stones.
Douglas	657,405	674,613	Sand and gravel, clays, stone, gem stones.
Eagle	6,306,750	7,842,867	Zinc, lead, silver, copper, gold, sand and gravel, pumice, gem stones.
Elbert	337,058	21,650	Sand and gravel, gem stones.
El Paso	1,645,542	1,494,603	Sand and gravel, stone, lime, clays, coal, gem stones.
Fremont	11,115,959	12,383,684	Cement, stone, coal, uranium ore, gypsum, petroleum, sand and gravel, clays, beryllium concentrate, feldspar, gem stones.
Garfield [5]	288,050	345,763	Stone, coal, lime, sand and gravel.
Gilpin	15,713	40,898	Gold, zinc, peat, lead, sand and gravel, silver, copper.
Grand	188,500	171,057	Sand and gravel, stone, gem stones.
Gunnison	1,642,084	1,654,372	Coal, stone, gold, sand and gravel, gem stones, silver, zinc, lead.
Hinsdale	10,012	(6 7)	Gold, silver, uranium ore, zinc.
Huerfano	(7)	(7)	Coal, clays, sand and gravel, stone.
Jackson	[4] [6] 3,019,214	[5] 1,873,522	Petroleum, sand and gravel, stone.
Jefferson	3,906,002	4,052,346	Sand and gravel, uranium ore, clays, stone, gold, feldspar, gem stones, silver.
Kiowa	221,100	165,200	Sand and gravel, petroleum.
Kit Carson	29,801	6,800	Sand and gravel.
Lake	66,676,115	65,759,348	Molybdenum, tungsten concentrate, sand and gravel, pyrites, tin, lead, silver, gold, copper, zinc, stone, gem stones.
La Plata [8]	341,274	517,640	Sand and gravel, coal, petroleum, gold, stone, copper, silver, lead, zinc.
Larimer	[4] [5] 12,617,445	13,078,529	Cement, stone, sand and gravel, petroleum, lime, gypsum, mica (scrap), beryllium concentrate.
Las Animas	6,662,062	7,920,825	Coal, sand and gravel, clays, carbon dioxide, stone.
Lincoln	146,650	110,000	Sand and gravel.
Logan [8]	[4] 13,477,100	12,996,702	Petroleum, sand and gravel, lime, stone.
Mesa [9]	4,364,110	4,104,368	Uranium ore, sand and gravel, coal, clays, gem stones, stone.
Mineral	1,398,533	1,422,006	Zinc. lead, silver, copper, gold, sand and gravel, gem stones.
Moffat [8]	[4] [6] 8,169,815	5,836,151	Petroleum, uranium ore, coal, sand and gravel, stone, gem stones, gold.
Montezuma [8]	[4] [6] 1,052,607	796,457	Sand and gravel, petroleum, carbon dioxide, stone, gold, silver.
Montrose [9]	11,125,164	11,929,872	Uranium ore, coal, sand and gravel, salt, stone, gem stones.
Morgan [8]	[4] 27,021,000	26,072,010	Petroleum, sand and gravel, lime, stone.
Otero	197,831	(7)	Lime, sand and gravel, stone.
Ouray	168,663	4,799,517	Zinc, lead, copper, gold, silver, sand and gravel, gem stones.
Park	53,042	72,123	Beryllium concentrate. stone, gold, gem stones, silver, copper, lead. tungsten concentrate, zinc.
Phillips	(8)	17,700	Sand and gravel.
Pitkin	(7)	5,107,472	Coal, iron ore, sand and gravel, lead, zinc, silver, copper, gem stones.
Prowers	86,600	248,000	Sand and gravel, petroleum.
Pueblo	(7)	722,118	Sand and gravel, clays, uranium ore, stone, gem stones.
Rio Blanco [10]	[4] 57,592,660	54,841,148	Petroleum, coal, uranium ore, sand and gravel, stone.
Rio Grande	1,150	200	Gem stones.
Routt	[4] 2,393,019	2,415,220	Coal, petroleum, sand and gravel, pumice, stone.
Saguache	1,650,855	1,401,794	Uranium ore. sand and gravel, gem stones, stone.
San Juan	300,772	42,206	Copper, lead, gold, silver, zinc, iron ore, gem stones, sand and gravel.
San Miguel [9]	11,745,179	7,404,485	Uranium ore, zinc, lead, copper, gold, silver, sand and gravel, iron ore, stone, gem stones.
Sedgwick [5]	31,860	(7)	Sand and gravel, lime, gem stones.

See footnotes at end of table.

TABLE 18.—Value of mineral production in Colorado, by counties [1]—Continued

County	1960	1961 [2]	Minerals produced in 1961 in order of value
Summit	591,718	323,999	Sand and gravel, zinc, lead, silver, gold, stone, copper.
Teller	1,219,496	990,708	Gold, stone, peat, sand and gravel, silver, gem stones, uranium ore.
Washington [8]	[4] 23,363,048	26,963,457	Petroleum, sand and gravel, stone.
Weld [8]	[4] 8,408,730	8,423,639	Petroleum, coal, sand and gravel, lime, stone, gem stones.
Yuma	138,900	224,200	Sand and gravel, petroleum.
Undistributed [11]	[4] 43,270,672	38,965,504	
Total [12]	[4] 343,104,000	343,256,000	

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[1] Denver County is not listed because no production was reported.
[2] Value of petroleum is preliminary.
[3] Excludes natural gas liquids.
[4] Revised figure.
[5] Excludes natural gas.
[6] Excludes vanadium.
[7] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[8] Excludes natural gas and natural gas liquids.
[9] Excludes natural gas and vanadium.
[10] Excludes natural gas, natural gas liquids, and vanadium.
[11] Includes vanadium, natural gas, natural gas liquids, some sand and gravel, gem stones, and stone (1961), and values indicated by footnote 7.
[12] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

Arapahoe.—The county was third in output and second in value of sand and gravel. Production at nine commercial and four Government-and-contractor operations was 31 percent more than in 1960. A small quantity of gold was recovered at one of the washing plants. Crushed stone was produced by contractors for the State highway department. Centennial Brick Co. produced miscellaneous clay for manufacturing building brick and heavy clay products.

Archuleta.—Petroleum production from 33 wells in the Chroma and Price Gramps fields was 14 percent below that of 1960. Sand and gravel and crushed stone were produced by contractors for the State highway department.

Baca.—Exploratory and development drilling was particularly rewarding in 1961. Three gasfields and one oilfield were discovered from 19 wells completed. Of 36 development wells completed, 22 were gas producers. Except for a small quantity of oil produced at the Prairie Dog field, discovered in 1958, the Flank field, a 1961 discovery, had the first significant production. Natural gas production, from the Greenwood and Prairie Dog fields, was below that of 1960. Sand and gravel was produced by a contractor and by construction and maintenance crews for the State highway department.

Bent.—Petroleum production declined sharply compared with that of 1960. That portion of the McClave field lying within the county was shut in, and only a small quantity of oil was recovered from the Bent's Fort field. Natural gas production from the Bent's Fort field, however, increased manyfold over that of 1960, and total production was approximately three times that in 1960, when production was almost entirely from the McClave field. Four exploratory wells and one development well were failures. Sand and gravel was produced by a contractor for the State highway department.

Boulder.—Nonmetals continued to provide most (80 percent) of the value of mineral production. Declines in value were recorded for fluorspar and sand and gravel, the most valuable of the mineral commodities. For the first time, lime used in refining sugar was included as a mineral commodity. Gains were recorded in the production value of uranium ore, stone, petroleum, and peat. Values of gold, silver, copper, and lead recovered from base metal ores declined sharply.

General Chemical operated its Burlington fluorspar mine and Valmont mill at a slightly lower rate than in 1960. Colorado Brick Co. produced miscellaneous clay at its Valmont pit, and Eldorado Clay Co. produced fire clay at its Nos. 1 and 2 pits for manufacturing building brick and other heavy clay products. Boulder Gravel Products, Inc., C & M Sand & Gravel Co. of Boulder, and Golden Transfer Co. produced construction sand and gravel and industrial sand. Paving gravel was produced by contractors and maintenance crews for the State highway department. Dimension sandstone (rough construction, rubble, flagging, and dressed) was produced by John Fitts, Jacobson Lyon Stone Co., Inc., Clyde Landau, Loukonen Bros. Stone Co.; and Sterling Contracting Co. A contractor and highway construction and maintenance crews produced crushed stone for road construction for the State highway department. The Great Western Sugar Co. produced quicklime for processing sugar beets.

Silver ore containing gold, copper, and lead was mined at the Blue Bird mine by Ruehlman Mining & Land Co. Dry gold ores were shipped from the Golden Age mine and from a mine near Jamestown. Uranium ore was produced at the Fair Day mine by Vitro Chemical Co. and processed at the plant at Salt Lake City, Utah.

Petroleum production from the seven-well Boulder field was slightly above that of 1960. Peat production, 39 percent above that of 1960, was used entirely as a soil conditioner and as an admixture for organic fertilizers.

Chaffee.—Production of beryllium concentrate (beryl), from the Echo No. 1 and Mine Site lodes, was 67 percent below that of 1960. The output was sold to the GSA purchase depot at Custer, S. Dak. Feldspar production from the Homestake strip mine by M. & S., Inc., was 27 percent below that of 1960. The output was ground by the Western Feldspar Milling Co. and shipped to plants in Illinois, Oklahoma, and Texas for manufacturing glass. Building sand and gravel was produced by Hart Rok Redi Mixt Concrete Co., and crews of the State and county highway departments produced paving sand and gravel for road construction. Colorado Granite Co. produced dressed dimension granite for monuments, and Colorado Granite Grit Corp. produced crushed granite for poultry grit. CF&I produced crushed limestone at its Monarch quarry for use as a flux at its steel plant in Pueblo. Crushed stone for road construction was produced by construction and maintenance crews of the State highway department.

Clear Creek.—Gold, silver, copper, lead, and zinc were recovered from ores and concentrates produced at six mines. Major production was from the Franklin Claim No. 73 by Franklin Silver Age Mining Co., the Bald Eagle mine operated by Jackpot Oil Co., and the Hall Tunnel by Cascade Mining Corp. Lesser quantities came from the Fairmont, Ruby Trust, and Sun & Moon mines. Seacol, Inc., shipped a small quantity of uranium ore from the Little Warrior mine to Canon City for processing. State highway maintenance crews and a contractor produced paving gravel for the State highway department. Booth & Smith Sand & Gravel Co. produced building sand and gravel. Contractors produced crushed stone for the State highway department for use in constructing Interstate Highway 70, a major east-west highway.

Costilla.—Pumice produced by Colorado Aggregate Co., Inc., at its Mesita Hill mine was 39 percent below that of 1960. State highway department crews produced paving gravel.

Custer.—Persolite Products, Inc., the only producer of crude perlite in the State, increased production from the Rosita mine 77 percent over that of 1960. The material was expanded at the company plant at Florence in Fremont County for use in building plaster, as loose-fill insulation, as a soil conditioner, and as concrete aggregate. Contractors for the Federal Bureau of Public Roads and the State highway department and maintenance crews of the State highway department produced paving sand and gravel. Total sand and gravel production increased twelvefold over that of 1960. H. K. Porter Co., Inc., produced fire clay for manufacturing refractories. Production was 24 percent below that of 1960. O. L. Braley produced crushed stone for use as an ornamental aggregate. S. N. N. Mining Co. produced pyrite at the Williams Tunnel.

Delta.—Coal production, from seven mines, was 19 percent less than that in 1960. Major production was by Juanita Coal & Coke Co. at the King mine. Delta Sand and Gravel Co. produced building sand and building and paving gravel. Maintenance crews and contractors produced paving sand and gravel for the State highway department, and the county highway department produced paving gravel. Output was 66 percent above that of 1960. Holly Sugar Co. produced quicklime for refining beet sugar.

Denver.—Five refineries in the Denver area (four in the city and county of Denver and one in Adams County at Derby) were operated throughout the year; throughput was 12.6 million barrels, an increase of 8 percent over that of 1960. The 12,000-barrel-a-day plant of Bay Petroleum Co. was acquired by Tenneco Oil Co. In June, Robinson Brick & Tile Co. announced plans to build in Denver a $1.75 million automated brick plant having a capacity of 60,000 bricks per day.

Dolores.—Rico Argentine Mining Co. operated its Rico Argentine mine and mill in the *Pioneer* mining district. In its annual report to the stockholders, the company stated that during the fiscal year ending June 30, 1961, 13,663 tons of lead-zinc ore was mined and milled; the mill operated at about 40 percent of capacity. Treatment of the ore resulted in the production of 58 ounces of gold, 48,471 ounces of silver, 779 tons of lead, and 827 tons of zinc. Development completed included 2,480 feet of drifts and crosscuts, 611 feet of raises, and 1,203 feet of long-hole drilling. Approximately 87 percent of this work was done in the Mountain Springs area and the remainder in the Argentine area. Pyrite for manufacturing sulfuric acid was mined in the Mountain Springs area. New roasters were placed into operation in the sulfuric acid plant, and other improvements were being made. Paving gravel was produced by Northwestern Engineering Co. and by maintenance crews of the State and county highway departments.

Douglas.—Building sand and building and paving gravel were produced by Garfield Gravel, Inc., Hall Sand & Gravel, Inc., Douglas County Sand & Gravel Co., and Platt Canyon Construction Co. Maintenance crews of the county highway department produced paving gravel. Total output of sand and gravel was 562,300 tons, a 95-

percent increase over that of 1960, reflecting increased activity on Interstate Highway 25, a major north-south highway. Clay production was 9 percent less than in 1960. Producers of fire clay were Denver Brick & Pipe Co. (Ringenberg mine), Helmer Bros. (Helmer mine), Robinson Brick & Tile Co. (Hogback mine), and Stroud O. Whisenhunt (Stevens mine); miscellaneous clay was produced by Robinson Brick & Tile Co. (Ute mine). The clays, except for a small quantity of fire clay used for refractories, were used for manufacturing building brick, tile, sewer pipe, and other clay products at company-owned plants in Denver. Helmer Bros. produced crushed limestone for use as a flux and for agricultural use.

Eagle.—The New Jersey Zinc Co. operated its Eagle mine and mill at Gilman at capacity throughout the year to achieve costs compatible with the prevailing prices of lead and zinc. Increased production of direct-shipping gold- and silver-bearing copper ore also aided in reducing unit costs. The mine was ranked first in the State in output of zinc and second in silver, copper, and lead. Development and exploratory work in the lower levels progressed as the production schedule permitted. Lava Products, Inc., and Roaring Fork Pumice Co. mined volcanic cinders at the Dotsero and Roaring Fork mines, respectively. Output was more than double that of 1960. Paving sand and gravel was produced by maintenance crews of the State and county highway departments; one commercial operator produced paving gravel. Output of sand and gravel was 72 percent below that of 1960.

El Paso.—Sand and gravel production continued to dominate the mineral industry in the county. Building and paving sand and gravel was produced by commercial operators. Major producers were Daniels Sand Co. Division, Transmix Concrete Co.; Broderick & Gibbons, Inc.; and Rocky Mountain Oil Paving, Inc. Maintenance crews of State and county highway departments, and the city of Colorado Springs produced building and paving sand and gravel. Contractors produced paving gravel for the State highway department. Total output was 19 percent below that of 1960. Crushed limestone for concrete aggregate was produced by Castle Concrete Co. Colorado Lime Co. produced crushed limestone for asphalt filler, coal dusting, and for manufacturing lime used in construction and ore concentration. Contractors produced crushed stone for the State highway department. National Clay Products Co., Robinson Brick & Tile Co., and Standard Fire Brick Co. produced fire clay and miscellaneous clay for manufacturing building brick, tile, and other clay products. Some of the fire clay was used in manufacturing refractory sleeves and nozzles. Coal production at the Franceville strip mine was slightly below that of 1960.

Fremont.—Nonmetals represented 86 percent of the total value of mineral production. The $12.4 million total value ranked the county seventh. Cement and stone were the principal commodities in terms of value of output, followed by coal and uranium ore. Beryllium concentrate (beryl) from the Devil's Hole and Mica Lode mines was 17 percent above that of 1960; all of the output was sold to the GSA purchase depot at Custer, S. Dak. Fire clay, used principally for manufacturing refractory brick and block, was produced by H. K. Porter Co., Inc., at its Flint and Salt Canyon mines, Irwin Clay Co.

at the I & E mine, and George O. Stroup at the 8-Mile and Phantom Canyon mines. Clay from the Phantom Canyon mine and a part of that from the I & E mine was used for manufacturing building brick and other heavy clay products. At the Triangle mine, Glen Lamberg & Sons produced bentonite which was used as a sealer in ponds and irrigation ditches. Total clay production was 30 percent below that of 1960. Shipments of portland cement by Ideal Cement Co. from its Portland plant were 9 percent above those of 1960. Pabco Building Materials Division, Fibreboard Paper Products Corp., produced gypsum for manufacturing wallboard and plaster products and for a retarder in portland cement at its plant at Florence. Output of gypsum by U.S. Soil Conditioning Co. was used for agricultural purposes. Building and paving sand and gravel and sand used for fill were produced by Sings Sand & Gravel, crews of the State and county highway departments, the city of Canon City, and the State penitentiary. Colonna Co. of Colorado, Inc., produced crushed marble at its Canon City and Salida quarries for terrazzo chips and crushed granite for ornamental aggregate. John Beaton and Lockhart & Sons also produced crushed granite for aggregate. The Denver & Rio Grande Western Railroad Co. produced granite for riprap. Crushed limestone was produced by CF&I and Colorado Limestone Co. for flux; by Frank H. Norberg Co. for flux, concrete aggregate, and manufacturing quicklime for sugar refining; and by Ideal Cement Co. for manufacturing cement. Cowan Bros. produced dimension marble and travertine for exterior building facing. Crushed sandstone produced by Standard Fire Brick Co. and Ray B. Sturbaum was used in manufacturing refractory silica brick; by Ideal Cement Co. for manufacturing cement; and by Forest Hamilton, Lockhart & Sons, and Ralph J. Pierce for use in terrazzo and as decorative gravel. Eighteen operations produced stone, compared with 12 in 1960, with a 2-percent increase in output. Lockhart & Sons produced a small quantity of feldspar at the Mica Lode mine.

Uranium ore production, from 16 operations by 7 operators, was 25 percent above that of 1960. Major producers were Juniper Oil and Mining Co. and Gunnison Mining Co. The ore was processed at plants of Cotter Corp. at Canon City and Gunnison Mining Co. at Gunnison. Coal production, from 17 underground and 2 strip mines, was 3 percent above that of 1960. Major producers were The Corley Co. at the Corley No. 1 strip and the Pioneer Canyon No. 2, Beer Coal & Construction Co. at the Beer strip, Selingo Coal Co. at the Canon Monarch No. 4, Canon Black Diamond Coal Co. at the Canon Black Diamond, Cedar Canon Coal Co. at the Cedar Canon, and Vento Coal Co. at the Vento. The county was ranked fifth in production of coal. Petroleum production from the 20-well Florence-Canon City field, discovered in 1862, was 4 percent above that of 1960.

Garfield.—Natural gas production, from 17 wells in 7 fields, was 19 percent above that of 1960. Coal production, from six underground mines, was 9 percent greater than that of 1960. Major producers were New Castle Coal Co. and William Haas, Jr. At Rifle, Union Carbide Nuclear Co. operated its 1,000-ton-a-day uranium ore processing plant for recovering uranium and vanadium. A new contract for purchasing uranium oxide concentrate through December 1966 was approved by AEC, effective April 1.

Crushed limestone mined and crushed by Basic Chemical Corp. from the Marblehead quarry was used for flux, roadstone, filler material, dust (for coal mines), and for manufacturing lime at the company Glenwood Springs lime plant. Most of the limestone mined by Frank H. Norberg Co., the only other stone producer, went into manufacturing lime. Sand and gravel output was 10,000 tons, produced by the Colorado Department of Highways maintenance crews for paving.

Gilpin.—Metals accounted for 78 percent of the value of mineral production. All of the metal output was derived from silver and gold lode ores, and from cleanup and placer operations. About 25 percent of the gold and 1 percent of the silver recovered came from four placer deposits: The Bobtail and the Smith-Tyler operated by R. F. Zacker, the Anna Mae operated by Robert Ray, and a placer on Clear Creek operated by LaVerne E. Gereaux. Gold, silver, copper, lead, and zinc were recovered from silver and gold ores produced at the Fannie Lode No. 6731 and the Glory Hole mines, operated by T. O. Fletcher and Glory Hole, Inc., respectively.

Peat humus mined from deposits near Black Hawk was used as a soil conditioner and as an admixture with organic fertilizers.

Grand.—Sand and gravel made up 91 percent of the value of mineral production in 1961. Of the 232,200-ton output, 228,500 tons was paving gravel produced by three contractors for the Colorado Department of Highways. Stone production totaled only 3,000 tons, nearly 11,000 tons less than in 1960. The Colorado Department of Highways used most of the stone for riprap and road material; a small quantity was used for erosion control on the Federal Bureau of Reclamation Big Thompson Project.

Gunnison.—Coal accounted for virtually all of the value of mineral output. Although production of coal from the eight underground mines was less than that of 1960, the value was greater. Columbia-Geneva Steel assumed operating control of the Somerset mine on January 1. The mine, purchased by the corporation in 1957, had been operated under lease by Minerals Development Corp. Columbia-Geneva was to use the output for manufacturing coke at its Geneva steel works in Utah. Bear Coal Co. installed new drills, mining machines, and transportation equipment at its Bear mine. Much of the output was used at the Western Colorado Power Co. Jim Bullock plant at Montrose.

Kerr-McGee Oil Industries, Inc., through its subsidiary, Kermac Nuclear Fuels Corp., acquired the Gunnison Mining Co. 200-ton-per-day uranium processing mill at Gunnison. The plant was used for processing ore from the company-owned Los Ochos mine in Saguache County and from independent operators on the Front Range.

All of the gold and part of the silver output came from gold ore produced at the Mountain Fern mine, operated by Ben Flick, Bill Wright, Clair Chase. All of the lead and zinc was produced from lead-zinc ore from the Copper Girl mine operated by J. C. Warde in the *Domingo (White Earth)* mining district. A small quantity of silver ore was shipped to the Asarco, El Paso (Tex.), smelter from the Forest Queen mine operated by John H. Hahn.

All of the mines operating in Gunnison County in 1960 were closed in 1961. The most significant factor in lowering metal production was the closing of the Micawber mine by Standard Metals Corp. in September 1960. E. I. du Pont de Nemours & Co., Inc., explored for columbium and rare-earth metals on its property near Powderhorn.

Hinsdale.—Vicker Bros. recovered gold, silver, and zinc (most of the mineral production) from gold ore produced at the Golden Wonder mine, *Lake City* mining district. Ore from this property was treated at the Midvale (Utah) concentrator operated by United States Smelting Refining and Mining Co. The Pelican mine closed in August 1960 and the Never Sweat mine was closed throughout 1961. Exploration and development was carried out from July through November at the Gold Quartz mine in the *Lake* mining district. A small quantity of uranium ore produced at the Beth mine by Dale Dunkel was shipped to Grand Junction for processing.

Huerfano.—Coal production from five mines, accounting for most of the value of mineral output, was 22 percent below that of 1960. Major producers were Delcarbon Coal Co. at the Calumet No. 2 mine and Morning Glory Coal Co. at the Morning Glory.

Standard Fire Brick Co. produced 4,200 tons of fire clay from the Chamblin mine; refractories and sewer pipe were made from the fire clay. Output of 8,800 tons of gravel was used for paving.

Jackson.—Petroleum production was 31 percent below that of 1960; all came from 54 wells in 8 fields. Natural gas production from the Canadian River field declined 37 percent. Carbon dioxide from wells in the McCallum field was vented. Of four development wells completed, three were successful; two were oil wells and one was a gas well.

Output of sand and gravel jumped from 34,500 tons in 1960 to 221,900 tons. The increase resulted mostly from gravel produced by the Colorado Department of Highways for resurfacing part of the Muddy Pass road. The output of stone, about 500 tons, also was used on the Muddy Pass road.

Jefferson.—Uranium ore production, largely from the Swartzwalder mine operated by Denver Golden Corp. and the Wright Lease operated by Cotter Corp., was 13 percent more than in 1960. The entire output was processed at the Cotter Corp. plant at Canon City.

The county was the principal source of clays produced in the State. Output, totaling 365,000 tons, was 71 percent more than in 1960. The increase was due mostly to the production of shale (miscellaneous clay) for later use for making lightweight aggregate in a new plant of The Idealite Co. (a wholly owned subsidiary of Ideal Cement Co.) under construction at Rocky Flats. Reportedly, the plant, virtually completed at yearend, was planned for an annual capacity of 300,000 cubic yards of lightweight aggregate. Other producers of miscellaneous clay were Clalite Aggregate Co., Cinder Concrete Products, Inc., Colorado Brick Co., Denver Brick & Pipe Co., George W. Parfet Estate, Inc., H. M. Rubey Clay Co., Lakewood Brick & Tile Co., and Robinson Brick & Tile Co. Fire clay was produced by Garnett C. Bennetts, Denver Brick & Pipe Co., Denver Fire Clay Co., Leland Doughty, John L. Harvey, and Robinson Brick & Tile Co. The clays were used mainly for making heavy clay products and lightweight aggregate. A small quantity was used for making refractory products.

Sand and gravel, the leading mineral commodity in terms of value of output, comprised 45 percent of the value of mineral production. The output—2 million tons—qualified Jefferson County as the second largest sand and gravel producer. Ninety percent of the sand and gravel was classified commercial; 1.1 million tons of the commercial sand and gravel went into building and 0.7 million for paving. Five of the eight commercial operators each produced over 100,000 tons; the largest single company output was nearly 600,000 tons. Maintenance crews of and three contractors for the Colorado Department of Highways produced 200,000 tons of paving gravel classified as Government-and-contractor.

Of the 12,200 tons of stone produced, 7,300 tons was stone screenings for road material produced by the Colorado Department of Highways. Colonna Co. of Colorado, Inc., Earl Cooper, and Lawrence W. Sillivan produced crushed quartz for use as terrazzo and decorative gravel. Morrison Stone Co., Ltd., produced crushed sandstone for driveways and walks. Dimension sandstone in rough blocks was quarried by Carl Quist. Calvin Palmer produced crushed marble, quartz, serpentine, and feldspar for use in terrazzo. Aggregates, Inc., made terrazzo and precast decorative stone panels at its plant north of Golden; all stone used was purchased.

Gold and silver were recovered as byproducts at four sand and gravel washing and screening plants: The Brannan Pit No. 11 and W. B. Kerkling placer operated by Kerkling & Slensker, the Lee Sand & Gravel Co. pit operated by Lee Sand & Gravel Co., and the Suburban Sand & Gravel Co. gravel pit operated by Robert R. Ray.

Kiowa.—Sand and gravel constituted 82 percent of the value of mineral production. Maintenance crews of and a contractor for the Colorado Department of Highways produced 189,200 tons, mostly for use in new road construction of Colorado Highway 96 between Haswell and Eads.

Petroleum production from the two-well Brandon field increased 25 percent over that of 1960. Development drilling resulted in five new gas wells in the McClave area; a northeast offset at the Brandon field pumped 63 barrels of oil a day from the Lansing-Kansas City formation.

Lake.—Climax Molybdenum Co. operated its molybdenum mine and plant at Climax. According to the company annual report to stockholders, the molybdenum mine maintained 24-hour, 7-day-per-week operations throughout the year. Output of ore averaged more than 34,000 tons per day, totaling 12,274,000. Ore drawn during the year was below average in grade and, as a result, molybdenum output declined from 49,631,000 pounds in 1960 to 48,074,000 pounds. Developments at the Ceresco Ridge zone reached the point where full-scale preparation for production from this area was reportedly justified. This extension of the ore body was to be mined from a system of loading and haulage drifts on the same altitude as the Phillipson level, but from a separate haulage adit. Plans called for a daily ore-production rate of 5,000 tons, to begin in 1965. Company officials reported commercial minable ore reserves, under 1961 economic conditions, of 462 million tons (including 19 million tons, an initial reserve for Ceresco Ridge). The reserves were estimated to contain in excess of 2 billion pounds of molybdenum. The full extent of the ore body was not defined.

Tungsten, tin, and pyrites were recovered as byproducts from the treatment of molybdenum ore. Because of improved metallurgical recoveries, according to the company annual report, Climax increased production of byproduct tungsten from 975,000 pounds in 1960 to 1,433,000 pounds.

Of the 86,500 tons of sand and gravel output, 12,900 tons was produced by the Colorado Department of Highways; the remainder was produced by contractors for construction on Colorado Highway 91 between Climax and Leadville.

La Plata.—Sand and gravel production totaled 304,400 tons and accounted for one-half of the value of mineral production. Burnett Construction Co. produced some building sand and gravel and paving gravel. Two contractors produced gravel and crushed stone for road construction on Colorado Highway 10 (U.S. Highway 160) between Bayfield and Yellow Jacket Pass. A small quantity of paving gravel was produced by the Colorado Department of Highways.

Petroleum production from the Red Mesa field was doubled, and natural gas production from the Ignacio field was increased 14 percent compared with that of 1960. Of the development wells completed, 38 were successful—36 were gas wells and 2 were oil wells. El Paso Natural Gas Co. operated its Ignacio natural gasoline plant and recovered 655,218 barrels of liquid products. Intake at the plant was 36 billion cubic feet of gas from Colorado wells; however, this figure included all gas that passed through the plant compressors. Only oil-well gas was processed.

Coal production from eight underground mines was slightly below that of 1960. Major producers were Victory Coal Co. at the Victory No. 3 mine and King Coal Co. at the King Coal mine. Virtually the entire output was shipped by truck to consumers.

VCA operated its 750-ton-a-day uranium-processing plant at Durango. In addition to uranium, vanadium oxide was recovered from ores that contained significant quantities. Crude ore came from company-owned mines and from independent-operator mines in Arizona, Colorado, New Mexico, and Utah.

Small quantities of gold, silver, lead, and zinc were recovered from gold ore obtained from the Bessie G mine, operated by La Plata Gold Corp. and L & M Mining Co. Copper Age Uranium Co. shipped a small quantity of copper ore from the Copper Age mine to the copper smelter of Inspiration Consolidated Copper Co., Inspiration, Ariz.

Larimer.—Nonmetals accounted for all of the value of mineral production except $500,000 for petroleum and $1,800 for beryllium concentrate. The increase of $461,000 in the value of mineral production was due mostly to increased cement shipments. Cement, all produced at the Boettcher plant of Ideal Cement Co., was by far the leading commodity. Limestone, chiefly for manufacturing cement, was the principal stone produced. Two operators produced limestone used to make lime at sugar refineries. Dimension sandstone was quarried by nine operators. One company quarried granite for monumental stone. Some granite and miscellaneous stone were used as riprap, road material, and for erosion control by State and Federal agencies. United States Gypsum Co. mined gypsum for use at its

Loveland plant. E. W. Munroe mined and shipped gypsum to the Boettcher cement plant for use as a portland cement retarder. Quicklime for refining sugar was made from limestone at the Loveland sugar factory of The Great Western Sugar Co. Scrap mica, mined at the Langston mine of Jolex Mica Co., Inc., was ground at the company plant near Fort Collins for use in well-drilling mud.

Output of cobbed beryl from pegmatites dropped from 24 tons in 1960 to only 3 tons; only 5 mines were operated compared with 43 in 1960. W. R. Allphin shipped hand-cobbed beryl from the Big Boulder mine to the GSA buying depot at Custer, S. Dak. Brungardt & Smith, operators of the Mona No. 4–5–9 mine, shipped hand-cobbed beryl to the GSA buying depot at Custer, S. Dak., and to the Loveland plant of Mincon. Stan Abromski, Joe Colacci, and Gene Darnel shipped hand-cobbed beryl to the Loveland plant of Mincon.

Three commercial and six Government-and-contractor operations produced 456,900 tons of sand and gravel, 45 percent less than in 1960. The decrease was attributed to a drop in road construction.

Petroleum production, from 38 wells in 6 fields, was 3 percent below that of 1960. The output came mostly from the Wellington, Fort Collins, and Clark Lake fields. Oil-well gas produced with the oil was used in the fields or flared. A new producing horizon (Lyons) in the Loveland field was discovered, and one successful development well was completed.

Las Animas.—Coal production, accounting for 96 percent of the value of mineral production, came from 11 underground mines and was 14 percent above that of 1960. The increase resulted largely from increased consumption for manufacturing coke by CF&I at its Minnequa works at Pueblo. CF&I operated the Allen mine, a completely mechanized operation and the largest producer in the State, at near capacity and abandoned its Frederick mine in May. No production had been recorded from the Frederick mine in 1961. Operation of the mine began in 1907, and total production was 20.5 million tons during its active life of 54 years. The mine, covering the largest underground area of any mine in the State, was one of the first in Colorado to use rock dust throughout the mine and to use roof bolts for roof control. Other major producers included Albert Iuppa & Son Coal Co. at the Starkville No. 4 mine, Rapson Coal Co. at the Rapson mine, and Eugene Lopez at the Peacock mine.

Carbon dioxide produced at the Nina View field was transported by pipeline to a plant in Bent County where it was converted to dry ice and liquid carbon dioxide. Output declined 48 percent below that of 1960.

Scott Mining produced slightly less than 10,000 tons of fire clay from the Santa Fe mine; the output was used to make firebrick and block refractories. Sand and gravel production was 264,800 tons, an increase of 75,300 tons over that of 1960. The major portion was produced by maintenance crews of the Colorado Department of Highways and Las Animas County Highway Department and a contractor for the Colorado Department of Highways to be used for paving. Small quantities of gravel produced by Ozello Construction Co. and Domenic Leone Construction Co. were used as railroad ballast and for paving, respectively. Stone (486 tons) was produced by a contractor for the Colorado Department of Highways for use as riprap.

Lincoln.—Sand and gravel output of 175,100 tons, produced by contractors for and maintenance crews of the Colorado Department of Highways and Lincoln County Highway Department for paving, accounted for all of the value of mineral production.

Logan.—The county ranked fourth in petroleum production and sixth in total value of mineral production. The $12.8 million value of petroleum production represented 99 percent of the total value of mineral output. Production, from 430 wells, was 3 percent below that of 1960. Three new fields were discovered. Of 48 development wells completed, 15 were successful; 13 were oil wells, and 2 were gas wells. Most of the development drilling was along the northwestern and southern edges of the West Padroni field, where 6 of the 13 oil wells were completed.

Natural gas processing plants were operated at the Lewis Creek, Little Hoot, Padroni, and Yenter fields by N. C. Ginther, and at the Mount Hope-Walker field by Kansas-Nebraska Natural Gas Co. Throughput at the plants was 10.4 billion cubic feet of gas with the recovery of 532,924 barrels of natural gas liquids. All of the plants were refrigeration-absorption plants except the one at the Little Hoot field, which was a refrigeration plant.

The Great Western Sugar Co. made quicklime from limestone at its Sterling beet-sugar factory for use in sugar refining. The Colorado Department of Highways produced 8,500 tons of stone screening for repairing roads. A total of 218,000 tons of sand and gravel, used mostly for paving, was produced by three commercial operators—Lawrence Padroni, Sterling Ready Mix Concrete Co., and Domenic Leone Construction Co.—and by the Colorado Department of Highways and Logan County Board of County Commissioners.

Mesa.—Uranium ore production, from 74 operations by 31 companies or individuals, accounted for 62 percent of the value of mineral output and was 18 percent below that of 1960. Major producers were Climax Uranium Co. at 15 operations and Beaver Mesa Uranium Co. at 6 operations. The output was processed at Durango, Grand Junction, Rifle, Uravan, Shiprock (N. Mex.), and Mexican Hat (Utah). Vanadium contained in the ore was recovered at all plants except the Mexican Hat plant.

Coal production, from seven underground mines, was 15 percent more than in 1960. The major producer, Kerr Coal Co. at the Cameo mine, delivered its entire output by belt conveyor from the mine portal to the PSC Cameo thermal powerplant. Other major producers were Medley Gearhart at the Roadside mine and Gearhart Coal Mine at the Gearhart mine. Production of natural gas, from 11 wells in 7 fields, was above that of 1960. Four new gasfields were discovered, one of which was an old well workover; three successful development wells were completed.

Sand and gravel production totaled 987,000 tons, 113,900 tons more than that of 1960. Seventy-seven percent of the output was from Government-and-contractor operations and was used for road construction. Two major road-construction projects completed during the year were Colorado Highway 6 (U.S. Highway 50) near Whitewater and part of Colorado Highway 141 south of Gateway. Sand and gravel was produced at three commercial operations by Fruita

Ready Mix Sand & Gravel Co., United Sand and Gravel Co., and Whitewater Sand & Gravel Co.; most of the output was used for building and paving. Junction Brick & Tile Co. produced miscellaneous clay for manufacturing building brick.

Mineral.—The entire production of gold, silver, copper, lead, and zinc was recovered from lead-zinc ore obtained from the Emperius mine operated by Emperius Mining Co. The value of this ore represented more than 98 percent of the value of the county mineral output. Lead-zinc ore from the mine was treated in the company mill at Creede; the lead and zinc concentrates were shipped, respectively, to the El Paso and Amarillo, Tex., smelters of Asarco.

One of the two OME contracts executed in 1961 in Colorado was with Humphreys Exploration Co. to explore for silver-lead-zinc. The contract was for expenditure of $187,600, with a 50-percent participation by the Government.

Moffat.—Petroleum production, from 123 wells in 23 fields, accounted for 70 percent of the value of mineral production and was 22 percent below that of 1960. Of 11 development wells completed, 8 were successful; 5 were oil wells and 3 were gas. Production of natural gas increased 10 percent. Mountain Fuel Supply Co. processed natural gas at its plants at the Hiawatha and Powder Wash fields.

Coal production from the Red Wing mine, operated by Colowyo Coal Co., declined slightly.

Uranium ore production, all from 16 operations by Trace Elements Corp., increased nearly threefold over that of 1960. Trace Elements Corp. operated its 300-ton-per-day processing plant at Maybell. A new contract for the purchase of uranium oxide concentrate by AEC was approved in March and replaced the original contract approved in November 1956 which was to have expired on March 31, 1962.

Orvie Zimmerman and the partnership of Farnsworth, Chambers, & Duke recovered a small quantity of gold from bench gravel in the *Four Mile* (*Timberlake*) and *Lay* mining districts.

Stone production increased from 3,200 tons in 1960 to 59,881 tons; output was used for new road construction in Dinosaur National Monument.

Montezuma.—Most of the sand and gravel was produced by Neilsons, Inc., and used for building, paving, and miscellaneous purposes.

Petroleum production, from nine wells in five fields, was 34 percent above that of 1960. Exploratory drilling resulted in four discoveries, two of which were worked-over old wells. Initial production rates were not encouraging. Of seven development wells completed, two were successful. Carbon dioxide produced from the Mississippi limestone and the Shinarump formations at the McElmo field was converted to dry ice by Colorado Carbonics Corp. at its plant at McElmo.

Montrose.—Montrose County continued to lead in production of uranium ore, with 42 percent of the State total. Value of the uranium ore shipped accounted for $11.4 million of the $11.9 million total for all minerals produced in the county. Production was from 299 operations by 70 companies, partners, or individuals. Major producers were Union Carbide Nuclear Co. from 132 operations, VCA from 44 operations, Climax Uranium Co. from 12 operations, Golden Cycle Mining Corp. from 2 operations, and Worcester Mines from 1. Total production was 6 percent above that of 1960; the grade of the ore mined was 0.26 percent (5.2 pounds per ton) uranium oxide. Vanadium oxide contained in uranium ores also was recovered. Union Carbide Nuclear Co. operated its 1,000-ton-a-day processing plant at Uravan. VCA completed construction of a 400-ton-a-day concentrator at Naturita and began operation in October. The concentrate was shipped to the processing plant at Durango for further treatment. The AEC approved a new contract for purchasing uranium oxide concentrates from plants of Union Carbide Nuclear Co. to replace one that was to expire on March 31, 1962. The new contract, effective April 1, 1961, provided for purchasing uranium concentrates from the Union Carbide plants at Uravan and at Rifle in Garfield County through December 31, 1966. Under terms of the contract part of mill capacity was reserved for treating ores from independent operators. The reserved part of available capacity could be increased or decreased within specified limits.

Output from the Navajo strip mine, operated by Edna Coal Co., was 12 percent above that of 1960 and was used at the Colorado-Ute Cooperative steam powerplant at Nucla. Natural gas production from the one well in the Montrose Dome field was 70 percent below that of 1960. Two wildcat wells completed during the year were failures.

Contractors for the Colorado Department of Highways produced and used 90,000 tons of paving gravel and 2,300 tons of stone for reworking Colorado Highway 92 between Crawford and Sapinero. C. E. Mills produced and sold paving gravel to Governmental agencies. The State's only salt output was that recovered from brines by Union Carbide Nuclear Co. for use at its Uravan uranium mill.

Morgan.—Petroleum and natural gas production, from 330 wells in 49 fields, was 4 and 12 percent, respectively, below that of 1960. Much of the decline was in the Adena-Adena South field where production was being stabilized through waterflooding and unit operation. Six discoveries and successful development well drilling (11 oil wells and 3 gas wells from 57 completions) partly offset the drop in production at the Adena field. Natural gasoline plants were operated by Pure Oil Co. at the Adena field, N.C. Ginther at the Bijou and Vallery fields, and Natural Gasoline Producers, Inc., at the Fort Morgan field. The plant at the Fort Morgan field was refrigeration; those at the Adena, Bijou, and Vallery fields were refrigeration-absorption. Throughput of the plants was 11 billion cubic feet of gas with the recovery of 1.3 million barrels of natural gas liquids.

Quicklime made from limestone at the Fort Morgan factory of The Great Western Sugar Co. was used in sugar refining. Sand and gravel production, 194,900 tons, was triple that of 1960. Output from commercial operations was virtually the same as that of 1960. The Morgan County Highway Department reported output of 131,000 tons of paving gravel compared with only 12,600 tons in 1960. Some paving gravel was produced by maintenance crews of the Colorado Department of Highways and by contractors. Stone production, 1,845 tons, was used in road construction between Fort Morgan and Brush.

Otero.—Reduction of sand and gravel output from 326,100 tons in 1960 to 153,600 tons in 1961 reflected a drop in road construction. Stone production increased from 3,753 tons in 1960 to 10,443 tons; about three-fourths of the output was produced by the Colorado Department of Highways and one-fourth by a contractor for the department. American Crystal Sugar Co. produced quicklime from limestone for use in sugar refining at its Rocky Ford factory.

Ouray.—Output of gold, silver, copper, lead, and zinc—which accounted for almost all of the value of mineral production—increased in value from $162,663 in 1960 to $4,797,257. This rise reflected the first full year of operation of the new 500-ton mill at the Camp Bird mine which opened in October 1960 and the production of ore from the Ouray County section of the Idarado mine. Of the seven mines producing copper, lead, and/or zinc in 1960, only the Camp Bird operated in 1961. Mines producing during 1961 that were not active in 1960 included the American Nettie operated by W. R. Nichols, the Wewissa operated by Warren Kuykendall, and the Idarado (Ouray County section) operated by Idarado Mining Co. Copper-lead-zinc and zinc concentrates from the Camp Bird mine were shipped to the El Paso and Amarillo, Tex., lead and zinc smelters, respectively, operated by Asarco.

Park.—U.S. Beryllium Corp. mined and sold to Mincon 805 tons of beryllium ore containing bertrandite and beryl from the Boomer and Redskin mines. At yearend, Mincon had virtually completed a 50-ton-per-day upgrading mill on Badger Flats for producing a beryllium concentrate from low-grade ores mined at the Boomer and Redskin mines and other prospects in the Badger Flats area. About 2½ tons of hand-cobbed beryl from the Hazel Marie mine, was purchased from Tri-State Metals Corp. by GSA at the buying depot in Custer, S. Dak.

Output of gold, silver, copper, lead, and zinc valued at $5,627 was recovered from small lots of ore shipped from the Betty and Evening Star mines.

Pitkin.—Coal production came from four underground mines and was 27 percent above that of 1960. Thompson Creek Coal and Coke Corp. operated its Thompson Creek Nos. 1, 2, and 3 mines; Mid-Continent Coal and Coke Co. operated the Dutch Creek mine. A natural gas field was discovered in January when a well in the Wolf Creek area was completed. Production was at a minimum before the field was shut in. A stepout well 1 mile to the southwest and another 2 miles to the north were failures.

Pitkin Iron Corp. shipped magnetite ore from the Cooper Fork deposit to CF&I. Montezuma Industries, Inc. produced a small quantity of lead ore from its Montezuma (Tam O'Shanter) zinc mine near Ashcroft.

Prowers.—Sand and gravel output accounted for all of the mineral production value of $248,000, except $3,000 for petroleum. Sand and gravel production was 198,700 tons, slightly more than triple that of 1960. The increase was due to requirements for road construction on Colorado Highway 6 (U.S. Highway 50) between Granada and

Holly. Valley Concrete Co., the only commercial operator, produced about the same quantity of building sand and gravel as in 1960.

Petroleum production came from the one-well Barrel Springs field in 1961. Gas production from the same field increased 54 percent. Of six exploratory wells completed, one was a successful gas well.

Pueblo.—With only five mines operating, compared with seven in 1960, clay production was less in 1961. Colorado Fire Clay Co., General Refractories Co., Harbison-Walker Refractories Co., and Standard Firebrick Co., produced fire clay used mostly for firebrick and block refractories. Summit Pressed Brick & Tile Co. produced miscellaneous clay for making building brick.

CF&I began constructing a $2.5 million plant to supply lime for its new oxygen-steel-producing facilities. In addition, CF&I experimented with introducing natural gas in the tuyères of its iron blast furnaces and reported some reduction in the quantity of coke required.

A decrease of 370,000 tons in the output of paving gravel accounted for most of the decrease in sand and gravel production, which dropped from 1,042,400 tons in 1960 to 571,300 tons. Only 42 tons of stone was produced for road construction, compared with 12,495 tons in 1960.

Uranium ore produced from the George Avery mine by Cliff & Creek Uranium Co. was 75 percent more than in 1960. The ore was processed at the Cotter Corp. plant at Canon City.

Rio Blanco.—The county continued to lead in petroleum production, with 41 percent of the State output from 511 wells in 14 fields. The Rangely field was the principal source, with production from the Mancos, Shinarump, and Weber formations. The Weber pool, with 366 wells, was operated by The California Co. under a unit agreement. The secondary-recovery program of water and gas injection continued as planned. Additional wells were converted to water and gas injection wells, and additional sources of water were investigated. Water from the White River proved unsatisfactory without treatment. A treatment plant was being planned. As of December 31, a cumulative total of 62.7 million barrels of water had been injected into the Weber reservoir, utilizing 61 water injection wells. Production from the Weber pool was 15.9 million barrels; a decline of 3 percent from that of 1960.

A new producing horizon, Wasatch, was discovered in the Piceance Creek field. Of 76 development wells completed, 23 were oil wells and 19 were gas wells. Most of the development drilling was on the western and southern edges of the Rangely field. Two oil wells were completed about 1½ miles east of any previous production in the Rangely area. Natural gas production was slightly below that of 1960. Gas from the Weber pool at the Rangely field was processed at six absorption plants located in the field. Absorption oil was transported by pipeline to a central processing plant where the natural gas liquids were recovered. The absorption oil was then returned to the absorption plants. Throughput of gas at the plants was 42.9 billion cubic feet; 1.4 million barrels of natural gas liquids was recovered. Residual gas was used in the field and at the absorption plants; approximately 70 percent was injected into the Weber pool for repressuring. As of December 31, a cumulative total of 265.6

billion cubic feet of gas had been injected through 19 injection wells. Uinta Refining Co. operated its 1,700-barrel-a-day refinery at Rangely. Throughput was approximately 368,000 barrels of crude oil. Coal production from the White River Fuel and Rienau mines was 4 percent below that of 1960.

Uranium ore production from seven operations by three companies, 49 percent below that of 1960, was shipped to a processing plant at Rifle.

Routt.—Coal production from three underground and two strip mines was 4 percent below that of 1960. Dry Creek Coal Co. operated the Cardinal mine; Routt Mining Corp., the Keystone; and Hayden Coal Co., the Babson—all underground mines. The Pittsburg & Midway Coal Mining Co. purchased the Edna strip mine from Edna Coal Co. and operated it as well as the Osage strip mine. The county was ranked fourth in coal production.

Petroleum production from 15 wells in 4 fields was 36 percent more than in 1960. Oil-well gas produced with the oil was flared.

Scoria mined by McCoy Aggregate Co. near Steamboat Springs was used for railroad ballast and for making cinder block. Sand and gravel production for paving totaled 197,900 tons, 13 percent below that of 1960. Most of the sand and gravel and all of the stone produced (825 tons) were used for paving Colorado Highway 2 (U.S. Highway 40) between Steamboat Springs and Rabbit Ears Pass.

Saguache.—Uranium-ore shipments accounted for all of the $1.4 million value of mineral production except for $14,785 which came from sand and gravel, gem stones, and stone. Uranium-ore production, from six operations by three companies, was 26 percent below that of 1960. Major production was by Gunnison Mining Co. and Pinnacle Exploration, Inc. The processing plant at Gunnison, operated by Gunnison Mining Co., was closed when the Los Ochos mine was exhausted.

The county led in value of gem materials collected: turquoise, agate, quartz crystal, and mineral specimens were valued at $5,750.

San Juan.—Total value of mineral production declined from $300,772 in 1960 to $42,206, primarily because of the closing, in early January, of the Shenandoah mine operated by Standard Metals Corp. near Silverton. A. A. McCluskey mined and shipped a small quantity of brown ore (limonite) from the South Mineral placer.

San Miguel.—Of the total mineral output value of $7.4 million, $4.5 million came from gold, silver, copper, lead, and zinc. Idarado Mining Co. led the State in output of these metals from copper-lead-zinc ore produced from the Idarado mine located in both Ouray and San Miguel Counties and treated in its mill near Telluride. Newmont Mining Corp., which owned 80.1 percent of Idarado Mining Co., stated in its annual report that Idarado milled 406,500 tons of ore in 1961 compared with 432,750 tons in 1960. The average metal content of the ore mined and milled was 0.071 ounce of gold per ton, 1.93 ounces of silver per ton, 2.34 percent lead, 0.77 percent copper, and 3.79 percent zinc. Ore reserves held by the company at yearend were given as 3,517,300 tons averaging 0.077 ounce of gold per ton, 2.4 ounces of silver per ton, 3.0 percent lead, 0.8 percent copper, and 4.2 percent zinc.

Iron ore production, all brown ore, came from the Iron Springs Placer mine, operated by C. K. Williams & Co., (used for paint pigments) and from the Iron Lode No. 3 mine operated by Theresa B. Robinson, (used for soil amendment).

Shipments of uranium ore from 94 operations by 46 companies or individuals was 22 percent below that of 1960. Major producers were Union Carbide Nuclear Corp. at 20 locations, Dulaney Mining Co. at 5 locations, Ortmayer Mining and Gayno Mining Co. at 1 location each. Output was shipped to processing plants at Durango, Grand Junction, Uravan, and Shiprock (N. Mex.) and to the upgrading plant at Slick Rock. All of these plants recovered vanadium oxide contained in the ore. No oil or gas production was reported in 1961. Exploratory drilling resulted in one oil well and one gas; development wells drilled were failures.

Sand and gravel production, all paving gravel, increased from 24,500 tons in 1960 to 124,500 tons. Except for 5,000 tons produced and used by maintenance crews of the Colorado Department of Highways, the paving gravel was used on two road construction projects, one between Ophir and Telluride and one south of Slick Rock Hill.

Sedgwick.—Quicklime for use in refining sugar was produced from limestone at the Ovid factory of The Great Western Sugar Co. Sand and gravel production, 130,400 tons, was double that of 1960. All of the output was paving gravel; 84,300 tons was produced for road maintenance by the Sedgwick County Highway Department and the rest was used on two road-construction projects of the Colorado Department of Highways. Natural gas production from the four-well Chappel field was 16 percent below that of 1960. The one exploratory well drilled was a failure.

Summit.—Sand and gravel output constituted 82 percent of the value of mineral production. The 313,600-ton output was only 22,000 tons less than in 1960. C. H. Giberson, the only commercial operator, produced building sand and gravel and fill gravel. Blue River Constructors, a contractor for the Board of Water Commissioners of the City and County of Denver on the Dillon Dam, dismantled its sand and gravel plant in September when sand and gravel requirements for the project were met. Before dismantling the plant, the company produced 63,840 tons of sand and gravel for use in concrete for tunnel lining. About 220,000 tons of paving gravel was used by contractors of the Colorado Department of Highways for road construction on Colorado Highway 9 between Dillon and Green Mountain Dam.

Most of the gold, silver, copper, lead, and zinc produced in Summit County came from three lode mines; only small quantities of gold and silver were recovered by placer mining at the Wapiti placer by Mineral Upgrading Industries. The Wellington mine, operated by Consolidated Parnett Corp. (Wellington Mine Association) was the largest producer, accounting for 83 percent of the gold, 95 percent of the silver, 98 percent of the lead, and all of the copper and zinc produced. On June 23, the company was awarded an OME contract for exploring and developing lead and zinc deposits. The contract was for $49,700, with 50-percent Government participation. Other lode mines active during the year were the Dunkin operated by

John T. O'Dowd and the Washington operated by R. J. Webb & J. P. Webb.

Teller.—Gold and silver were produced at 12 active mines. The Ajax mine operated by The Golden Cycle Corp., the major producer in the county, was ranked second in the State.

The Golden Cycle Corp. reported to its stockholders that production at the Ajax Mine, before it closed on December 31, was 30,504 tons with an average value per ton of $26.28. During the year, 39,881 tons of ore was treated at the Carlton mill before it was placed on standby; 37,877 tons was mined and 2,004 tons was dump ore. Average value per ton of all ore treated was $23.12. Other major producers were the United Gold mines (The United Gold Mines Co.) and the Deadwood mine (Deadwood Leasing Co.).

Peat humus, produced at the same rate as in 1960, was used as a soil conditioner and as an admixture with organic fertilizers.

Washington.—Washington County was ranked second in petroleum production and third in total value of mineral production. The value of petroleum production represented 99 percent of the total value of mineral production. The 9.3 million barrels produced, from 367 wells in 68 fields, was 16 percent above that of 1960. The county led all others in eastern Colorado in the number of exploratory and development wells completed during the year, although the number of wells completed was below that of 1960. Of all new locations staked in eastern Colorado in the last 2 months of 1961, 42 percent were in Washington County.

The interest generated in the county was credited to the expiration of old leases which permitted several major operators to acquire substantial holdings; the discovery of the Bison field in sec. 7, T. 4 S., R. 53 W. late in 1960; and the marked success of development drilling in the field during 1961. By yearend there were 14 producing wells in the field and an apparent discovery, late in the year, of a new oil pool about 4 miles east of the Rush-Willadel field discovered in 1952. A drill-stem test of the well in sec. 28, T. 3 S., R. 50 W., tentatively designated as the Pod field, recovered 500 feet of oil from the J sandstone.

One of the more important 1961 discoveries was a new producing horizon in sec. 26, T. 3 S., R. 51 W., about a mile southwest of the one-well Rush-Willadel field. The well, considered to be in the field, pumped 166 barrels of oil a day from the J sandstone. A north offset was successful. Field development outside the Bison area was scattered and relatively unsuccessful. Single new producing wells were added to each of six widely scattered fields.

Continental Oil Co. operated natural gas processing plants at the Little Beaver field, and Akron Gasoline Co. operated its plant at the West-Xenia field through June. Throughput at the plants was 2.8 billion cubic feet of gas, with the recovery of 585,745 barrels of natural gas liquids.

Sand and gravel production of 330,100 was nearly double that of 1960. Except for 200 tons of paving gravel produced by the Colorado Department of Highways, the output was paving gravel produced by two contractors for the Colorado Department of Highways on two road construction projects, one on Colorado Highway 54 (U.S. Highway 34) between Akron and Otis and one on Colorado Highway 102 (U.S.

Highway 36) west of Lindon. The stone output also was used for road construction.

Weld.—Output of coal and petroleum accounted for 91 percent of the total value of mineral production in Weld County, which was ranked third in coal production and fifth in petroleum production.

Coal output, from six underground mines, was 7 percent above that of 1960. The Imperial Coal Co. operated the Eagle and Imperial mines; The Clayton Coal Co., the Lincoln and Washington mines; Boulder Valley Coal Co., the Boulder Valley No. 3 mine; and McNeil Coal Corp., the Sterling mine. Much of the output was used by PSC of Colorado at its steam generating plants in the Denver metropolitan area.

Petroleum production, from 107 wells in 31 fields, was 6 percent lower than in 1960. Limited exploratory and development drilling was not too successful. Of 11 exploratory wells completed, there were no discoveries, and of 6 development wells completed, 1 oil well in the New Rayner field was successful.

Weld County was one of five in the State having an output of sand and gravel over 1 million tons; the production totaled 1,100,900 tons, only 1,500 tons less than in 1960. Five operations were commercial and 10 were Government-and-contractor, compared with 4 and 5, respectively, in 1960. The five commercial operators—Bailey Construction Co., Domenic Leone Construction Co., Max Torrez Sand & Gravel, Elsie McCave, and Moffat & Son—produced 115,400 tons of sand and gravel, which was used for building, paving, and fill. Maintenance crews of the city of Greeley, Weld County Highway Department, and Colorado Department of Highways produced 164,000 tons of paving gravel. Six contractors for the Colorado Department of Highways produced 821,500 tons of paving gravel for road construction. The two largest road projects completed were on Colorado Highway 85 (Interstate 25) between Lafayette Junction and Colorado Highway 56 and on Colorado Highway 2 (Interstate 805) east and west of Keenesburg. Stone production, 13,248 tons, was used in road construction.

Quicklime for sugar refining was produced from limestone at the Eaton, Greeley, and Windsor factories of The Great Western Sugar Co.

Yuma.—Sand and gravel production accounted for $215,200 of the $224,200 value of mineral production. The output, 219,600 tons, was slightly more than double that of 1960. Except for a small quantity of paving gravel produced by a contractor for the city of Wray, the output consisted of paving gravel produced for road repairs by the Yuma County Highway Department and the Colorado Department of Highways.

Petroleum production from the two-well Laird field, discovered in 1960, was 28 percent above that of 1960. At yearend one of the wells had been shut in.

The Mineral Industry of Connecticut

This chapter has been prepared under a cooperative agreement for collecting mineral data (except mineral fuels) between the Bureau of Mines, U.S. Department of the Interior, and the Connecticut Geological and Natural History Survey.

By Stanley A. Feitler[1]

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CONNECTICUT's mineral production reached a new high in 1961, exceeding the value for 1957, the previous high year, by 3 percent. During the 10-year period, 1952–61, the value of mineral production rose from $7.1 million to $16.5 million. Rapid growth in residential and industrial building contributed to this remarkable 10-year growth record, but the most important factor was the demand for mineral raw materials created by the expanding State and Federal highway-construction program. In 1961, 95 percent of the total value of mineral production was used in construction. Prices were generally about the same as in 1960.

TABLE 1.—Mineral production in Connecticut[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate……short tons	16	$9	2	$1
Clays……do	207,458	308	[2] 149,101	[2] 260
Gem stones	([3])	7	([3])	9
Lime……short tons	34,664	616	32,987	589
Sand and gravel……thousand short tons	6,575	5,960	7,499	6,633
Stone……do	5,057	8,313	5,206	8,616
Value of items that cannot be disclosed: Feldspar, kaolin (1961), mica (1960 sheet, 1961 sheet and scrap), and peat		140		491
Total Connecticut[4]		15,255		16,501

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes kaolin; included with "Value of items that cannot be disclosed."
[3] Weight not recorded.
[4] Total adjusted to eliminate duplicating value of stone.

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[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

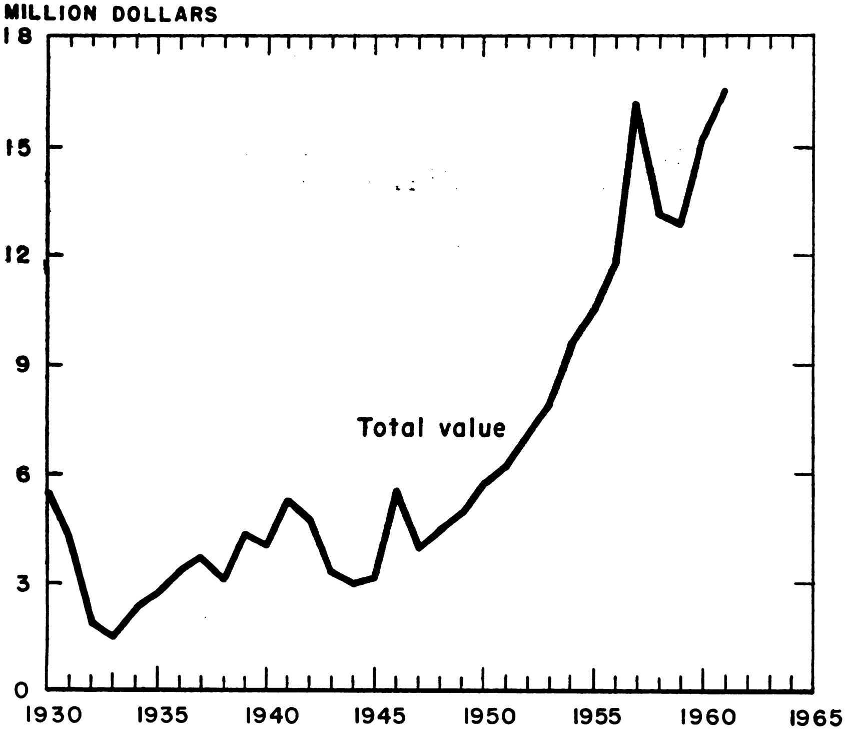

FIGURE 1.—Value of mineral production in Connecticut, 1930–61.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Reduced demand for building brick resulted in a 28-percent decrease in tonnage of clay mined. Miscellaneous clay was mined at seven pits in three counties for use in the manufacture of building brick and flowerpots. Production of a small quantity of kaolin was reported—the first in recent years. The Brick Service & Development Association continued to promote the use of building brick by the construction industry.

Feldspar.—The new plant of The Feldspar Corp. in Middlesex County was in full operation. Feldspar mined to supply the new flotation plant was responsible for a large increase in tonnage and value of crude feldspar. Most of the mill output was consumed in the manufacture of glass containers—a new market for Connecticut feldspar. Crude mill feed was recovered from nearby pegmatite bodies and trucked to the crushing plant at the mill. Non-feldspar minerals were separated by flotation after the crushed rock had been ground and deslimed. Glass-grade feldspar was shipped after flotation, but material for use in ceramics was ground to finer sizes as specified by the purchaser.

Output of crude feldspar to supply two long-established dry-grinding plants was less than in 1960. Potash feldspar was mined selectively from pegmatites in Middlesex County. After hand sorting at the mines, the output was trucked to nearby mills for grinding. Most of the ground material was for ceramics, but part was used in soaps and cleaning compounds.

Gem Stones.—The value of gem stones and mineral specimens recovered was greater than in 1960. Most of the output was the result of work by mineral collectors and amateur lapidarists, who obtained most of the material from pegmatites in the western half of the State.

Lime.—Output of lime was 5 percent below that of 1960. Quicklime for chemical use accounted for 51 percent of the total; 45 percent was used in construction, and 4 percent was used for agriculture. New England Lime Co., active in Litchfield County, was acquired by Chas. Pfizer & Co. in October.

Mica.—Production of strategic-quality sheet mica increased markedly. The entire output of full-trim and hand-cobbed mica was sold to General Services Administration (GSA) at its Franklin, N.H., purchase depot for the national stockpile. Scrap mica was recovered in Connecticut as a byproduct of feldspar flotation for the first time. The byproduct scrap mica was dry-ground in a new mill in Middlesex County for use in roofing materials.

Sand and Gravel.—Tonnage and value of commercially produced sand and gravel for building and paving increased, but the value per ton was lower for the second successive year. The price of material for most uses decreased about 4 percent. Continued growth of the highway construction program in Connecticut was reflected in increased output by Government-and-contractor operations. Hartford County led the State in sand and gravel output, followed by New Haven and Fairfield Counties. The quantity of prepared material rose to 80 percent of the output by commercial producers. Deliveries continued to be mainly (95 percent) by truck; the rest were by railroad.

Stone.—Basalt, with 93 percent of the tonnage and 84 percent of the value, continued to be the leading type of stone produced. Most of the basalt was used for concrete aggregate and roadstone; other uses, amounting to 3 percent of the total, included riprap and railroad ballast. Limestone was mined in Litchfield County, principally for use in agriculture and lime manufacture. Granite was quarried for dimension stone and crushed for concrete aggregate and roadstone. Quartzite was mined and sized for use in glassmaking and as foundry sand, abrasive, and roofing granules. Quartz recovered in the process of beneficiating feldspar by flotation was used in manufacturing glass, and a small tonnage of hand-sorted quartz recovered from a pegmatite dike was used in terrazzo and decorative masonry.

TABLE 2.—Sand and gravel sold or used by producers, by class of operations and uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Molding	2,000	$1,000	2,062	$1,138
Structural	1,272,192	1,232,534	1,754,735	1,659,192
Paving	950,249	875,915	974,987	883,193
Other	135,749	120,548	118,415	106,701
Gravel:				
Structural	1,013,016	1,461,801	1,155,090	1,654,840
Paving	922,468	1,076,217	726,092	800,157
Fill	355,838	219,802	236,262	141,519
Other	86,061	58,398	120,326	168,340
Undistributed [1]	377,726	197,492	581,288	317,159
Total	5,115,299	5,243,707	5,669,257	5,732,239
Government-and-contractor operations:				
Sand: Paving	63,007	21,904	45,000	13,500
Gravel: Paving	1,396,739	694,370	1,784,550	887,475
Total	1,459,746	716,274	1,829,550	900,975
Grand total	6,575,045	5,959,981	7,498,807	6,633,214

[1] Includes filter sand, railroad ballast (1960), and fill sand.

TABLE 3.—Stone sold or used by producers, by uses [1]

Use	1960		1961	
	Short tons	Value	Short tons	Value
Dimension stone (approximate short tons)	6,628	$158,944	12,068	$226,749
Crushed and broken stone:				
Agstone	62,441	286,000	62,667	284,008
Concrete, roadstone	4,714,944	7,076,804	4,829,654	7,152,750
Railroad ballast	47,465	59,332	45,132	56,540
Riprap	111,204	162,950	98,733	153,733
Undistributed [2]	114,781	568,709	157,431	741,798
Total	5,057,463	8,312,739	5,205,685	8,615,578

[1] Includes production by Government-and-contractor operations.
[2] Includes flux, ground quartz, and other stone.

METALS

Intense competition and low profit margins impelled the nonferrous metals industry to provide improved efficiency, product diversification, and financial flexibility. Mergers were effected; scattered operations were centralized; procedures and equipment were improved; and unprofitable operations were discontinued. Research was directed to developing new products and uses and to improving existing products and methods. The research center of the Metals Division of National Distillers and Chemical Corp. was moved from Bridgeport to the plant of the newly acquired Seymour Manufacturing Co., at Seymour. Acme Wire Co., Anaconda American Brass Co., and Pratt & Whitney Aircraft Co. occupied new laboratories in New Haven County. Active research projects by these and other companies included studies of a new copper bonding process, recovery of alumina from clay, the properties of copper at low temperatures, the effect of vacuum-melting techniques on certain base metals, and the properties of rhenium alloys.

Beryllium Concentrate.—Production of hand-cobbed beryl reported from Litchfield, Middlesex, and New Haven Counties was appreciably lower than in 1960. Most of the output was sold at the GSA depot at Franklin, N.H., for the national stockpile.

MINERAL FUELS

Coke.—Byproduct coke ovens were operated by Connecticut Coke Co., a subsidiary of Eastern Gas & Fuel Associates. The coke and chemical byproducts produced at the New Haven plant were marketed principally in the Northeast.

Peat.—Reed-sedge peat was produced in Middlesex County for use as a soil conditioner. A new bog in Middlesex County was being prepared for production.

REVIEW BY COUNTIES

Production of sand and gravel and stone by Government-and-contractor operations, as reported by the State highway department, was not attributed to specific counties. Two municipalities in Hartford County reported production of sand and gravel by their own crews; it was used for road repairs.

Fairfield.—Tonnage and value of sand and gravel were slightly higher than in 1960. The output was used principally for building and highway construction; minor quantities were used for fill and sanding roads. The larger producers included Bernard J. Dolan Co., Bethel; Grasso Construction Co., Bridgeport; and Lambert, Inc., Brookfield Center. Zoning restrictions caused one large producer to discontinue production at Fairfield. About 90 percent of the sand and gravel was washed and screened; all was delivered by truck. Basalt was produced at one quarry. The rock was broken coarsely by light blasting to yield the maximum coarse material for use as riprap. Pegmatites continued to be the chief source for gem stones and mineral specimens. Collectors recovered material near Trumbull, New Hartford, and Roxbury.

Carpenter Steel Co. of New England produced a variety of steel products in two electric furnaces at its Bridgeport plant. The Seymour plant of Bridgeport Brass Co., Division of National Distillers & Chemical Corp. provided space for the new research center of the Metals Division of National Distillers. Among the research programs planned was one on copper and aluminum alloys. Five scattered operations, including research and metalworking, were brought together by Norden Division of United Aircraft Corp. in a new plant at Norwalk.

Hartford.—Hartford County became first in value of mineral production, as its output increased 13 percent to $5.1 million. The quantity of basalt mined, crushed, and screened for use as concrete aggregate, roadstone and riprap was greater than in 1960. Sherman-Tomasso Concrete, Inc., formed by a merger of Angelo Tomasso, Inc., with

TABLE 4.—Value of mineral production in Connecticut, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Fairfield	$1,261,573	$1,296,939	Sand and gravel, stone, gem stones.
Hartford	4,474,450	5,055,412	Stone, sand and gravel, clays, gem stones.
Litchfield	1,776,475	1,800,410	Stone, lime, sand and gravel, gem stones, clays.
Middlesex	497,982	942,721	Feldspar, sand and gravel, clays, stone, peat, mica, gem stones, beryllium.
New Haven	4,384,825	4,367,020	Stone, sand and gravel, clays, gem stones, mica, beryllium.
New London	808,698	952,060	Stone, sand and gravel.
Tolland	(1)	(1)	Sand and gravel, stone.
Windham	(1)	(1)	Do.
Undistributed [2]	2,050,911	2,086,868	
Total	15,255,000	16,501,000	

[1] Figure withheld to avoid disclosing individual company confidential data.

[2] Includes some stone, sand and gravel, and mica that cannot be assigned to specific counties and values indicated by footnote 1.

Sherman Sand & Stone Co., operated two basalt quarries and preparation plants near Plainville. Other active basalt operations were the Edward Balf Co., Newington; Materials Service, Inc., East Granby; New Haven Trap Rock Co., Plainville; and Arborio & Sons, Inc., Farmington. Tower Hill Granite Co. quarried and dressed granite for use as construction stone. The granite quarry of P. A. Armando near Glastonbury was idle.

Sand and gravel output increased from 1.6 million to 2 million tons, but the average value was 85 cents a ton, 4 cents less than in 1960. Among the larger of the 20 producing companies were Dunning Sand and Gravel Co., Inc., Farmington; Russak Brothers, Inc., Plainville; Connecticut Sand & Stone Corp., Avon; and Costello Construction Corp., which operated pits at Bloomfield and Newington. Most of the tonnage was consumed in the construction of buildings and roads, but some was used for sanding roads, filtration, and as railroad ballast. Three-fourths of the sand and gravel produced in the county was washed and screened before shipment.

The Keller-Whilldin Pottery Co., which began operations in Connecticut in 1960, produced miscellaneous clay for the manufacture of flowerpots to supply the New England States. Clay was mined for building brick by Kelsey Ferguson Brick Co., East Windsor Hill; Donnelly Brick Co., Kensington; Carpenter Brick Co., South Windsor; and Edward W. Mack & Son, Windsor. Gem stones and mineral specimens were recovered from various localities by local and out-of-State mineral collectors. Pratt & Whitney Aircraft Division, United Aircraft Corp., continued research on columbium-base alloys and ceramics for the aerospace field in a laboratory provided for advanced materials research at the North Haven plant.

Litchfield.—Limestone production continued to expand, as producers reported increased tonnage and value. The New England Lime Co., which became a division of Chas. Pfizer & Co., Inc., during the year, mined limestone for use in lime manufacture, for agstone, and for use as a filler in asphalt and rubber. More than half the lime produced was used in the manufacture of calcium and magnesium at the company's Canaan plant. Most of the remainder was used in mason's lime.

Output from limestone quarries of Conklin Limestone Co., Inc., and United States Gypsum Co. was used as agstone, paint filler, stucco, and metallurgical flux. Building Materials, Inc., produced basalt at its Woodbury quarry for use as concrete aggregate, roadstone, and riprap.

Sand and gravel was produced from pits near Canaan, Lime Rock, Litchfield, New Milford, and Torrington. Tonnage shipped was lower than in 1960. Pits of Great Mount Sand & GravelCo., Inc., Banbury, and Sodom Sand & Gravel, Canaan, were idle. Trucks were used to deliver all the sand and gravel output; 87 percent was washed and screened before shipment. Most of the tonnage was used for building, paving, and highway ice control.

Hand-cobbed beryl was produced at Parker's quarry near Woodbury, but no sales were reported. Nutmeg Mining Co. continued exploration of a nickel, copper, and cobalt property on Mt. Prospect, a few miles west of Litchfield. High-purity calcium and magnesium were produced at Nelco Metals plant, which was acquired by Chas. Pfizer & Co. as part of the New England Lime Co. The Torrington Co. began construction of a plant addition to house a new wiremill.

Middlesex.—Feldspar had the greatest value of any mineral product in the county because of the additional quantity mined to supply the new flotation plant of the Feldspar Corp. Crude feldspar was mined at a group of pegmatites and trucked a short distance to the mill, where it was beneficiated by flotation for use principally in manufacturing glass, but part of the output was used in manufacturing ceramic products. Connecticut feldspar has not previously been sold in significant quantities for use in manufacturing glass. The Feldspar Corp. also sold scrap mica and quartz recovered as coproducts in the feldspar flotation process. The quartz was used in glassmaking and the mica, processed by Deneen Mica Co. of Connecticut, was used in roofing materials.

John W. Nance mined feldspar at the Hale pegmatite deposit for the Eureka Feldspar Mining & Milling Co. The crude material was mined selectively and hand-sorted in the pit before being trucked to the Eureka Co. grinding plant, where it was ground for use in manufacturing ceramic products. Potash feldspar from a nearby pegmatite was mined by Worth Spar Co., Inc., for use as an abrasive and nonskid additive in a floor-cleaning compound.

Quantity and value of sand and gravel produced was higher than in 1960. The principal producer was Shore Line Washed Sand and Stone Co., Inc., Madison; pits also were operated at East Hampton, Middletown, Clinton, Deep River, and Moodus. The output was used for building and highway construction, fill, and highway ice control. Miscellaneous clay was mined from a pit near Middletown by the Michael Kane Brick Co. for use in manufacturing building brick. Kaolin mined from a pit on Sharon Mountain by Carpenter Brick Co. was shipped to the company's brickyard in Hartford County for use in manufacturing building brick.

Full-trim, strategic-quality mica from the Victoria mine and Worth Spar mine near East Hampton was recovered, prepared, and sold to GSA at its Franklin, N.H., purchase depot for the national stockpile. The Andrews quarry near Portland and the Victoria mine, East

Hampton, yielded small quantities of hand-cobbed beryl, which was sold to GSA for the national stockpile. Collectors of gem stones and mineral specimens recovered a variety of material from the pegmatites of Middlesex County. Cedar Swamp Peat Co. produced reed-sedge peat near Old Saybrook. Black Peat Humus Co. prepared a bog near Haddam Neck in Haddam Township for production during 1961.

New Haven.—Basalt produced during 1961 was slightly less than in 1960. Charles W. Blakeslee & Sons, Inc., operated the Pine Rock quarry, Hamden; A. N. Farnham, Inc., mined near New Haven; and the York Hill Trap Rock Co. quarried basalt at a mine near Meriden. The New Haven Trap Rock Co., with quarries at North Branford and Middlefield, was the largest producer in the country. Installation of new equipment increased the capacity of the North Branford plant to 1,200 tons per hour. The quarry face was 70 feet high and about 7,000 feet long. Blastholes put down by two churn drills were 26 feet on centers and had 30 feet of burden. Oversize rock was broken by chain and drop ball and loading was by three 2½-cubic-yard power shovels. The plant had facilities for loading finished stone into barges, railroad cars, and trucks. Granite blocks for rough architectural stone were quarried at Stoney Creek near Branford by Castellucia and Sons, Inc. The large blocks were reduced to dimension sizes before being shipped to the consumer.

Output of sand and gravel increased, and New Haven County maintained its position as the third largest producer in the State. Among the larger operations were those of Elm City Construction Co., North Haven; Beard Sand & Gravel Co., Inc., Milford; and Cinque Brothers Co. and Guilford Sand & Gravel Co., with plants at Northford and Guilford. Significant quantities of sand and gravel also were produced from pits at New Haven, Wallingford, Devon, and Waterbury. Washed and screened material, representing 60 percent of the total, was used for building and paving; the remainder, bank-run material, was used for fill.

Output of miscellaneous clay was sharply curtailed, as the Stiles Corp., North Haven, closed one of its two brick plants during 1961. Plans for modernizing brickmaking facilities were completed. Strategic-quality hand-cobbed mica produced at the Benson mine near Southbury was sold to GSA for the national stockpile. Gem and mineral collectors continued to recover material from pegmatite and other mineral localities.

Hand-cobbed beryl from the Southford pegmatite, Southbury, was sold to GSA at the Franklin, N.H., purchase depot. Lump quartz from the massive core of this pegmatite body was shipped for use in terrazzo and cast concrete. Research in metals continued to expand, as Anaconda American Brass Co. and Acme Wire Co. opened new research centers at Waterbury and Hamden, respectively. Chase Brass & Copper Co., a unit of Kennecott Copper Corp., announced a new copper joining process developed at its Waterbury Research Laboratory. Research aimed at developing an economic method for producing alumina from clay and shale was underway at Olin Mathieson Corp.'s research center at New Haven.

New London.—Quartzite was mined in increased quantity by Connecticut Silica Co. at its North Stonington mine. The product was crushed and sized to specifications for use in manufacturing glass and as foundry, abrasive, and plaster sand. Part of the output was used for roofing granules and as a filler.

Granite from its Montville quarry was mined and crushed by Barrett Division of Allied Chemical Corp. for use as concrete aggregate, roadstone, and riprap. Dimension granite was quarried by Mill Stone Granite Quarry, Waterford, and Golden Pink Granite Quarry, East Lyme. The output was used for architectural and construction stone, monuments, rubble, and irregular-shaped stones for facing buildings and bridges. The pink granite quarry of E. Locarno & Sons, Niantic, was idle. Sand and gravel for building, paving, and fill were produced by six companies operating gravel pits at various localities.

Tolland.—Earl L. Parker, Inc., Tolland, and Myron M. Lee, Bolton, produced sand and gravel for building, paving, fill, and for sanding roads. Vernon Sand & Gravel Co., Vernon, discontinued operations. Banded gneiss was quarried at Skyline Quarry near Crystal Lake. The output was marketed as dressed building stone and rubble.

Windham.—R. A. Rawson Sand & Gravel, Putnam, and Ernest Joly & Sons, Danielson, produced sand and gravel for building, paving, and fill. Dunning Sand & Stone Co., Inc., Wauregan, produced washed and screened sand and gravel for building and paving. Oversize basalt boulders recovered in the pit were crushed and sold for concrete aggregate, roadstone, and railroad ballast. Shipments by the Dunning Co. were about equally divided between truck and railroad. R. B. Marriott & Sons produced curbing and rubble from the company's granite quarry near Oneco.

The Mineral Industry of Delaware

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey.

By Charles C. Yeloushan[1]

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MINERAL production in Delaware consisted primarily of sand and gravel operations with stone and clay comprising the remainder. The total value of Delaware's 1961 mineral production increased 6 percent over 1960 to $1.1 million. Sand and gravel output decreased in quantity but increased in value. Production of stone and clay remained unchanged.

Reported employment by the mineral industries averaged 67 men working daily and totaled 108,000 man-hours, decreasing 6 and 11 percent, respectively, from 1960. Three lost-time injuries were reported.

TABLE 1.—Mineral production in Delaware[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel..................thousand short tons..	1,084	$907	961	$970
Value of items that cannot be disclosed: Clay, gem stones, and stone..........	....	82	....	83
Total Delaware..........	....	989	....	1,053

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—The entire production of miscellaneous clay was used in manufacturing building brick in New Castle County. Production of clays was slightly higher than in 1960 because building activity increased.

Gem Stones.—Mineral specimens were collected by members of mineral and lapidary clubs.

Gypsum.—A modern $7.5 million gypsum products plant was opened by Bestwall Gypsum Co. at Wilmington. The company planned to

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[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

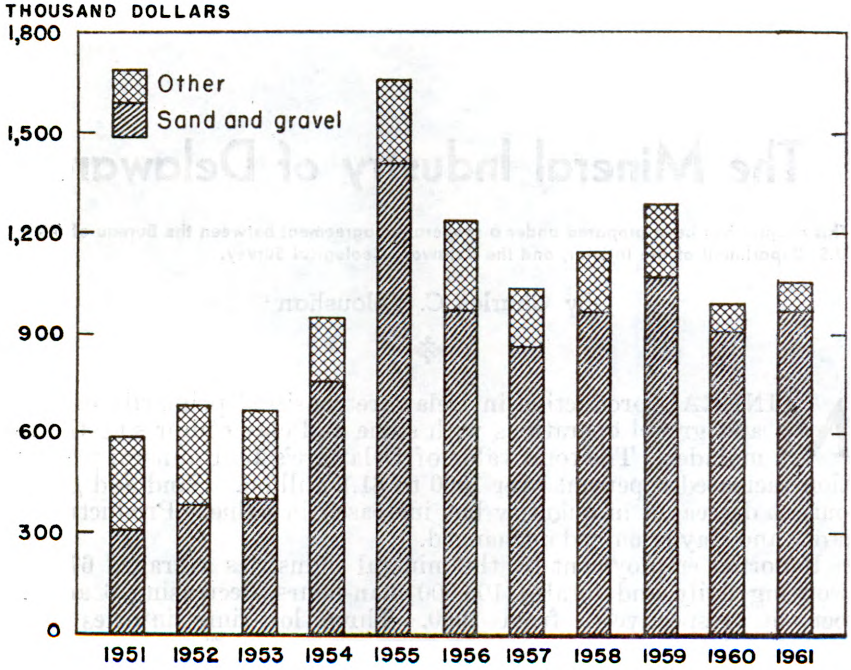

FIGURE 1.—Value of mineral production in Delaware, 1951–61.

import 200,000 tons of gypsum ore annually from Nova Scotia and the Dominican Republic and produce enough wallboard, lath, and sheathing to complete 30,000 homes annually. In addition, commercial rock and agricultural gypsum were to be sold.

Sand and Gravel.—Sand and gravel increased 7 percent in value and furnished 92 percent of the mineral industry in the State despite an 11-percent decrease in tonnage. Lower output was attributed to the general decrease in building and paving activities. No sand or gravel was produced by the State highway department. Sand, supplying 33 percent of the total tonnage, was marketed as building, paving, fill, and engine sand. Gravel was marketed for building and paving. Sand and gravel for paving purposes represented 79 percent of the total tonnage; building material represented 14 percent.

Trucks transported almost the entire production; railroads the remainder. More than half the sand and gravel output, 15 percent more than in 1960, was processed by washing or screening.

Sand and gravel producers reported a total of 62 production employees working 96,820 man-hours, about the same as in 1960.

Stone.—The only stone produced in the State was gabbro, classified as granite for statistical purposes. Concrete aggregate and roadstone for roadbuilding continued as the market for this crushed stone.

Sulfur.—Tidewater Oil Co. reported increased byproduct sulfur production at its Delaware City refinery in New Castle County. On January 1, 1961, the refinery operating capacity was 140,000 barrels of crude oil per day; sulfur was recovered by the Claus process.

METALS

Manganese steel castings and chrome molybdenum steel castings were produced at the New Castle plant of American Manganese Steel Division, American Brake Shoe & Foundry Co. Bronze, brass, aluminum, and zinc casting alloys; solder; babbitts; and type metal were produced at the Wilmington smelter and refinery of North American Smelting Co. from primary metals shipped from other States and foreign countries.

Shipments of iron and steel scrap from yards in Wilmington, Dover, and Smyrna consisted primarily of Nos. 1 and 2 Heavy Melting steel, cast-iron scrap other than borings, stainless steel, No. 1 electric furnace bundles, and unprepared scrap.

Iron sinter was produced and cobalt was recovered by Pyrites Co., Inc., at Wilmington from a pyrite concentrate originating from Bethlehem Cornwall Corp. in Pennsylvania and processed at Sparrows Point, Md. Sinter also was produced from aniline sludge and flue dust.

Seven basic open-hearth furnaces with an annual ingot capacity of 506,500 short tons were operated by Phoenix Steel Corp. at Claymont. The Claymont plant processed the steel in two plate rolling mills, an electric weld mill for large diameter pipe, a fabricating shop, and a flanging, pressing, and dished and spun head department. The company blast furnace at Chester, Pa., furnished the pig iron for the open-hearth furnaces.

REVIEW BY COUNTIES

Kent.—Sand and gravel production in four places increased 16 percent over 1960. Kent continued to rank second as a mineral-producing county in the State, contributing 13 percent of the total sand and gravel production. Sand and gravel was mostly washed or screened. Clough & Caulk Sand and Gravel washed and screened sand and gravel for building and paving purposes near Wyoming. Fisher M. Carpenter marketed some bank gravel near Milford. St. Jones River Gravel Co. processed sand and gravel near Dover for building and paving. Processed sand for building purposes was marketed by Barber Sand & Gravel Co. near Harrington from a dredging operation. All sand and gravel produced was transported to market by truck.

New Castle.—As the leading mineral-producing county in the State, New Castle supplied 84 percent of the total mineral production and 81 percent of the total sand and gravel production. Output of sand and gravel decreased 13 percent in tonnage compared with 1960 but increased 11 percent in value. Less than half the sand and gravel produced was washed or screened. Delaware Sand & Gravel Co. processed sand and gravel for building, paving, and fill from a stationary plant near New Castle. Petrillo Brothers, Inc., produced sand and gravel for paving purposes near Wilmington. Whittington's Sand & Gravel Co. near Bear produced mostly prepared gravel for building and paving. Parkway Gravel produced unprocessed gravel for paving from portable plants near Sheldon Farms and

Jefferson Farms. Trucks transported the entire output of sand and gravel to nearby markets.

Petrillo Bros., Inc., continued to crush stone from the Shellpot quarry, a gabbro deposit near Wilmington, by a multiple-bench operation. The crushed stone was transported by trucks to nearby roadbuilding projects.

Delaware Brick Co. produced miscellaneous clay from an open pit for use in its brick plant near New Castle. Building brick was produced from this clay after it was crushed, ground, and screened.

Sussex.—Sand and gravel production from Sussex County represented only 6 percent of the State total, decreasing 34 percent from 1960. About half the sand and gravel was washed or screened. Lewes Sand Co. produced unprocessed sand for engine use from a stationary plant at Lewes. The sand was transported from the plant by railroad. Henry G. Graves & Sons, Inc., processed sand at a portable plant near Georgetown for paving purposes. Atkins Brothers produced sand and gravel for building, fill, and miscellaneous uses at a stationary plant near Millsboro.

The Mineral Industry of Florida

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Florida.

By Lawrence E. Shirley[1] and William D. Reves[2]

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FLORIDA established a new high in the production of mineral commodities in 1961, with a total value of $191 million. Production value was 8 percent higher than in 1960, and continued a trend that began in 1951 when total mineral production value was recorded at only $79 million. Since 1957 total value has increased more than $50 million. Florida has led the Nation in production of phosphate rock for 68 consecutive years, zircon for 22 consecutive years, stauro-

TABLE 1.—Mineral production in Florida[1]

Minera	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays……thousand short tons	[2] 252	[2] $6,357	513	$7,202
Gem stones	(3)	(4)	(3)	(4)
Lime……thousand short tons	151	2,611	213	3,555
Natural gas……million cubic feet	30	5	30	5
Peat……short tons	39,275	162	24,573	149
Petroleum (crude)……thousand 42-gallon barrels	369	(5)	[6] 371	(5)
Phosphate rock……thousand long tons	12,321	82,530	13,789	95,590
Sand and gravel……thousand short tons	6,757	5,559	6,530	5,577
Stone……do	[7] 27,629	[7] 37,419	28,855	36,305
Titanium concentrates thousand short tons, gross weight	286	7,489	(5)	(5)
Value of items that cannot be disclosed: Cement, clays (kaolin and miscellaneous clay, 1960), magnesium compounds, rare-earth metal concentrates (1961), staurolite, stone (dimension limestone, 1961, and marl, 1960), zirconium concentrates, and values indicated by footnote 5		[8] 38,154		44,797
Total Florida [9]		[8] 176,923		190,933

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes kaolin and miscellaneous clay, included with "Value of items that cannot be disclosed."
[3] Weight not recorded.
[4] Less than $500.
[5] Figure withheld to avoid disclosing individual company confidential data.
[6] Preliminary figure.
[7] Excludes certain stone, included with "Value of items that cannot be disclosed."
[8] Revised figure.
[9] Total adjusted to eliminate duplicating value of stone and clay.

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.
[2] Geologist, Florida Geological Survey, Tallahassee, Fla.

lite for 5 consecutive years, and fuller's earth for 4 consecutive years. The State has ranked second in output of titanium concentrates for 6 consecutive years, and has led the Southeastern States in total stone production for the last 2 years. Florida ranked third in output of crushed oystershell, an increasingly important raw material in the cement and lime industries.

During the year increases were recorded in the production of fuller's earth, lime, magnesium compounds, crude petroleum, phosphate rock, rare-earth concentrates, stone, and zircon. Decreases were recorded in the production of cement, both masonry and portland, kaolin and miscellaneous clay, peat, sand and gravel, staurolite, and titanium concentrates.

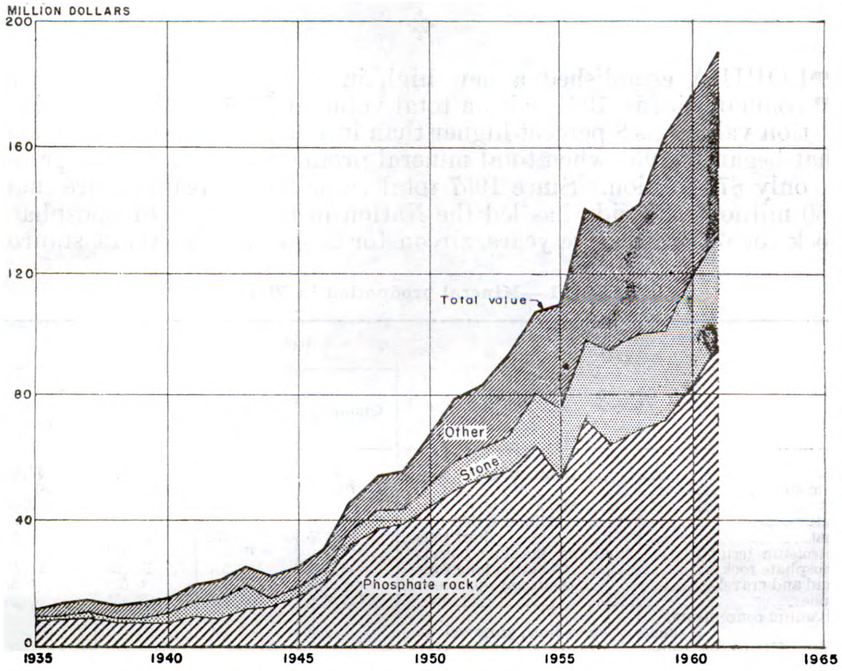

FIGURE 1.—Value of phosphate rock, stone, and total value of mineral production in Florida, 1935–61.

Leading phosphate rock producers were International Minerals & Chemical Corp., American Agricultural Chemical Co., Virginia-Carolina Chemical Corp., and American Cyanamid Co. Leading cement manufacturers were General Portland Cement Co. and Lehigh Portland Cement Co. Leading crushed stone producers were Florida Rock Products Co., Seminole Rock Products Co., Camp Concrete Rock Co., and Ideal Crushed Stone Co.

Employment and Injuries.—Reports submitted to the Federal Bureau of Mines by producers in the mineral industries indicated a small overall decrease in the number of active mines, quarries, and mills. The number of people working daily in all mines, quarries, and mills increased 5 percent over 1960 employment, a net gain of 370 persons. Average active days worked decreased 3 percent. Total man-hours increased 2 percent, or 362,000 hours, over the 1960 total; there were increases in metal and nonmetal mines and mills and sand and gravel mines. Injuries per million man-hours decreased from 15 to 10; nonfatal injuries decreased from 250 to 164 in all industries, and there were no fatal injuries, compared with 3 in 1960. The 1961 injury record was one of the best that the State had experienced.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operations	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960: [1]							
Nonmetal mines and mills	32	3,287	306	8,056,771	1	59	7
Quarries and mills	103	2,891	298	6,887,561	1	159	23
Metal mines and mills	5	282	349	794,634	1	3	5
Sand and gravel mines	42	381	303	922,524	----------	29	31
Total	182	6,841	304	16,661,490	3	250	15
1961: [2]							
Nonmetal mines and mills	31	3,844	292	8,990,903	----------	47	5
Quarries and mills	101	2,593	294	6,105,005	----------	92	15
Metal mines and mills	5	386	332	1,024,405	----------	8	8
Sand and gravel mines	43	388	291	903,289	----------	17	19
Total	180	7,211	295	17,023,602	----------	164	10

[1] Excludes officeworkers.
[2] Preliminary figures.

Consumption, Trade, and Markets.—Florida's port expansion was indicative of the State's growth in foreign trade and markets and its continued need for meeting increasing volume with expanded facilities. Construction on the new $20 million port of Miami continued on schedule. The new port, located on Dodge Island, will not be completed until 1967; the first phase of the job, however, consisting of dredging sand out of the bay to connect islands where port facilities will be housed, was completed. During 1962, a new highway and railroad bridge, costing $2.8 million, was to be constructed, and paving, drainage, and installation of site facilities was to be started.

The availability of deepwater port facilities at Blount Island, 10 miles upstream in the St. Johns River, and 15 miles from Jacksonville, was announced by the Duval County Port and Industrial Authority. A new seaport was slated for south Dade County, near Homestead, according to announcements made about midyear, and construction might begin within 2 years. The new industrial port was to be constructed by Daniel K. Ludwig and National Bulk Carriers, Inc., a large shipping concern. Location of the Homestead port will be on a 2-mile-square area of land along the bayfront, due east of Homestead Air Force Base. Included in the seaport planning was a channel 5 miles long, with sufficient depth to serve oceangoing freighters.

Gypsum, perlite, and vermiculite were brought in from other States and foreign countries, and processed for consumption in Florida and nearby States. United States Gypsum Co., near Jacksonville, used gypsum rock from Nova Scotia and had a fleet of five self-unloading ships serving east coast plants; they could transfer more than 1,000 tons of rock per hour from ship to shore. Vermiculite, processed by three plants, was brought in from South Carolina, Montana, and South Africa. Crude perlite, also processed at three plants, was received from Colorado.

Phosphate rock exports decreased slightly from 1960; 27 percent of the State's marketable product was exported, 2 percent less than in 1960. Most of the rock was shipped either from the port of Tampa or from Boca Grande, both served by railroads from the phosphate district. Domestic consumption of phosphate increased considerably, placing new demands on the processing phase of the industry.

Expanding consumption and markets of fuller's earth, lime, magnesium compounds, rare-earth concentrates, and zircon were indicated by increased output.

Trends and Developments.—Florida continued its rapid industrial growth; in the first 6 months of the year, 329 new plants and major expansions were announced in all industries. Dade County, rapidly becoming industrialized, led with 113 new plants, followed by Palm Beach County with 30 and Pinellas County with 27.

New demands for electric power, to supply growing industrial and residential centers, exceeded all expectations and new facilities were needed to handle the demands. Florida Power & Light Co. expected to spend $128 million for construction in the next 3 years; the company spent $60 million in 1961. The funds were earmarked for final construction on one 300,000-kw generating plant at Riviera, scheduled to begin operating in early 1962, and an additional 300,000-kw generator at Riviera, scheduled to being operating in April 1963. The company's two 425,000-kw generators at Port Everglades were scheduled to become operative in 1964 and 1965. Other plant additions included Gulf Power Co., Crist plant, 75,000 kw; Florida Power & Light Co., Port Everglades plant, 200,000 kw; and city of Tallahassee, St. Marks plant, 22,000 kw.

The U.S. Atomic Energy Commission announced in May that it was cancelling an agreement with the Florida West Coast and Florida East Coast Nuclear groups to build a 50,000-kw reactor near Pierce. Factors working against the program were the reluctance of most utilities to accept the financial burden and the difficulty of finding sites remote enough for safety and yet close enough for economic distribution to markets.

Roadbuilding and bridge-construction programs outlined during the year indicated the continued high demand for sand and gravel and stone as roadbuilding materials. The State road department released a 5-year plan for construction of 503 miles of Interstate highways by 1966, at a cost of over $300 million. The Interstate road program, as of the fiscal year ending June 30, 1961, showed 44.4 miles of road completed during the year to full or acceptable standards; 88.3 miles open to traffic; and 264.8 miles of road under construction or in progress. Total designated system mileage for the State was 1,120 miles. The Florida State Turnpike Authority issued bonds with a value of $155 million to finance an extension of the Sunshine State Parkway. The extension, 159 miles long, would be from Fort Pierce northwestward through central Florida to Orlando and would end at Wildwood.

The State signed the Nation's first statutory interstate atomic agreement, about midyear, which placed Florida in the Southern Interstate Nuclear Compact, composed of seven Southern States. The State also appropriated more than $1.5 million to build facilities at the University of Florida, Gainesville, for nuclear studies.

Texas Gulf Sulphur Co., continuing a trend to set up molten sulfur facilities at strategic marketing points, established a new supply terminal at Jacksonville. Many of the large sulfur consumers in the State were changing to molten sulfur because of the economic advantages of using the molten form instead of the solid lump form. Freeport Sulfur Co. made the largest shipment of molten sulfur in the history of the industry, 16,100 long tons, transported by the vessel *Louisiana Sulphur* from Port Sulphur, La., to the company terminal at Tampa. Freeport instituted a $23 million program to move sulfur in liquid form.

Legislation and Government Programs.—The Bureau of Sanitary Engineering, Florida State Board of Health, continued its study of the air-pollution problem. Many of the phosphate companies and manufacturers of fertilizer assisted in the study. The companies also conducted independent studies and installed new equipment to alleviate air pollution.

The Federal Bureau of Mines, at its Norris, Tenn., Metallurgy Research Center, conducted tests on various Florida clay samples as part of its cooperative agreement with the Florida Geological Survey.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Cement output declined for the second successive year; output for all types of cement decreased 6 percent in quantity and value from 1960. Two companies produced portland and masonry cements at four plants in three counties. Portland cement decreased 6 percent in quantity and value; masonry cement decreased 12 percent in quantity and 10 percent in value. The continued decrease in production was attributed to weakness in the construction industry and an increase in competitive markets.

Lehigh Portland Cement Co. operated plants in Flagler County near Bunnell, and in Broward County, near Miami. The company expanded its land reclamation and reforestation program by placing 600 acres of landholdings in Flagler County, which will not be used for cement-producing purposes during the next 25 years, into the program. In addition, acreage from which coquina shell had been extracted for cement-producing purposes was reclaimed under the program. Lehigh's Bunnell plant was presented with a safety award by the Portland Cement Association.

General Portland Cement Co. operated plants at Tampa and near Miami. Expansion completed during the year at the Tampa plant increased plant annual capacity by 3 million barrels. Annual capacity of both plants was expected to be 9.5 million barrels in 1962.

Universal Atlas Cement Division of United States Steel Co. purchased the cement storage and handling facilities of Ponce Products Co. at Port Everglades about midyear. Universal Atlas also purchased the cement transport ship, S.S. *Florida State*, from Ponce, but Ponce was to continue to operate the ship to bring cement from Ponce Cement Industries of Puerto Rico to Port Everglades. The Puerto Rican company was to manufacture cement to Universal Atlas specifications for sale under the Atlas name. Ponce Products controlled Maule Industries, Inc., one of south Florida's largest concrete products companies.

Clays.—Total clay production, including fuller's earth, kaolin, and miscellaneous clay, decreased 11 percent in quantity but increased 2 percent in value over 1960. Florida, for the fourth consecutive year, ranked first in production of fuller's earth, and output established a new high. Fuller's earth was mined in Gadsden County by Minerals & Chemicals Philipp Corp., Floridin Co., Inc., and Magnet Cove Barium Corp., listed in order of output.

Kaolin output continued a decline begun in 1960; tonnage decreased 11 percent and value 9 percent. Edgar Plastic Kaolin Co. and United Clay Mines Corp., both in Putnam County, were the only kaolin producers.

Miscellaneous clay production decreased 23 percent in quantity and 24 percent in value, owing principally to a 33-percent decrease in the quantity of clay used for cement manufacture. General Portland Cement Co. mined clay in Citrus County for use in cement. Solite Corp., Clay County, mined miscellaneous clay for use in lightweight aggregate produced at its Green Cove Springs plant. Appalachee Correctional Institute, Gadsden County, mined a small quantity of clay for use in making brick.

Near yearend Minerals & Chemicals Philipp Corp. announced the availability of new organic-modified clays for use in the conditioning of readily caking high-analysis granular fertilizers. The company reported that the material, a nontoxic, magnesium aluminum silicate, had been used at a 2-percent coating concentration on ammonium nitrate with effectiveness comparable to the use of 3-percent diatomaceous earth. The use of clay in conditioning and anticaking agents to produce free flow in dry formulations of all types was gaining in popularity and new industrial applications were being found not only in the fertilizer industry but in cement, explosives, insecticides, and other industries.

Florida's first clay-pipe plant, a $3 million installation, was described.[3] The plant, on a 40-acre site about 2 miles south of Ocala, was constructed by U.S. Concrete Pipe Co., a wholly owned subsidiary of Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. Raw material for the operation, shipped into the State in hopper cars, was shale and clay mined in Cordova, Ala. The plant produced pipe for the expanding residential construction market.

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[3] Brick and Clay Record. Clay Pipe Joins Florida Boom. V. 139, No. 1, July 1961, pp. 40–43, 66, 67.

Gem Stones.—Gem stone production, as reported by collectors, dealers, and others, continued to decline, and was valued at less than $500.

Gypsum.—United States Gypsum Co., near Jacksonville, Duval County, calcined gypsum for use in manufacturing building products. National Gypsum Co. continued construction of a gypsum products plant at Port of Tampa, Hillsborough County. The construction of a dock and unloading facilities for handling gypsum ore from ship to shore also was in progress. The plant was scheduled to use gypsum ore transported by ship from the company's deposits in Nova Scotia.

Lime.—Lime was produced in five counties by five companies; three of the operations were captive. Lime output continued an upward trend, increasing 41 percent in quantity and 36 percent in value over the 1960 figures and establishing a record year. Dixie Lime & Stone Co. (formerly Dixie Lime Products Co.), Ocala No. 1 limekiln produced quicklime and hydrated lime for masonry and chemical and industrial uses. Captive lime producers were Buckeye Cellulose Corp., Taylor County, Michigan Chemical Corp., Gulf County, and the city of Miami, Dade County, listed in order of output. Buckeye Cellulose produced 120,000 tons of chemical lime valued at more than $2 million. The city of Miami produced 27,000 tons of chemical lime valued at $281,000 at its Hialeah limekiln.

One new commercial lime operation was added when Chemical Lime, Inc., Brooksville, completed and placed into operation, near yearend, its $2.5 million plant. The new plant, owned jointly by Camp Concrete Rock Co., Ocala, and Lee Lime, Inc., Lee, Mass., used the fluid-bed method of making lime in an upright kiln. The plant output was expected to be about 200 tons per day. The facilities were to operate three shifts a day, 7 days a week.

Magnesia.—Michigan Chemical Corp., Port Saint Joe, in its third year of production of magnesium compounds from sea water, more than trebled its 1960 output. The company produced refractory and caustic-calcined magnesium compounds for use by the plastic, refractories, fertilizer, chemical, paper, glass, rubber, petroleum, and other industries.

Perlite.—Crude perlite from deposits in Western States was processed by three companies in three counties for use in building plaster, concrete aggregate, and soil conditioning. Combined output of the three processors was 7,000 tons valued at $452,000, compared with 9,000 tons valued at $599,000 in 1960, a decrease of 22 percent in tonnage and 25 percent in value. Tennessee Products & Chemical Co., Duval County, was the largest producer, followed by Airlite Processing Corp. of Florida, Indian River County, and Perlite, Inc., Duval County.

Phosphate Rock.—For the 68th consecutive year Florida led the Nation in total marketable production of phosphate rock. Tonnage and value reached new records during the year, as in 1960. Combined marketable production of all types of phosphate rock totaled 13.8 million tons valued at $95.6 million, an increase of 12 percent in tonnage and 16 percent in value over the 1960 figures. Land-pebble production again comprised 99 percent of the output and was primarily responsible for the total gain. Hard-rock output increased 5 percent in tonnage and 11 percent in value; soft-rock output continued a decline begun in 1959; it decreased 10 percent in tonnage and 16 percent in value from 1960.

TABLE 3.—Phosphate rock sold or used by producers, by uses

Use	1960			1961		
	Long tons	Value		Long tons	Value	
		Total	Average per ton		Total	Average per ton
Ordinary superphosphate	4,155,626	$28,402,633	$6.83	4,316,257	$31,359,113	$7.27
Triple superphosphate	1,571,823	10,883,760	6.92	2,023,112	14,677,734	7.26
Phosphoric acid (wet-process)	2,100,706	13,094,121	6.23	1,900,621	12,476,084	6.56
Direct application to the soil	556,348	3,894,853	7.00	471,206	3,426,949	7.27
Elemental phosphorus, ferrophosphorus, phosphoric acid	387,041	2,563,812	6.62	376,844	2,629,320	6.98
Stock and poultry feed [1]	336,723	2,383,986	7.08	260,452	1,904,636	7.31
Nitraphosphate	----------	----------	----------	14,700	106,640	7.25
Other fertilizer	----------	----------	----------	20,000	145,600	7.28
Exports	3,142,415	20,693,052	6.59	3,396,128	22,643,729	6.67
Total	12,250,682	81,916,217	6.69	12,779,320	89,369,805	6.99

[1] Includes nitraphosphate and other fertilizer.

TABLE 4.—Marketable production of phosphate rock

(Thousand long tons and thousand dollars)

Year	Hard rock		Soft rock		Land pebble		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	84	$673	76	$474	9,748	$59,461	9,908	$60,608
1957	80	689	52	365	10,059	63,736	10,191	64,789
1958	87	737	53	414	10,711	67,800	10,851	68,951
1959	78	666	52	414	11,434	70,128	11,564	71,208
1960	77	670	47	384	12,197	81,476	12,321	82,530
1961	81	746	42	325	13,666	94,519	13,789	95,590

Mine production of land-pebble crude ore, dry basis, was 54,037,000 long tons with a P_2O_5 content of 6,499,000 tons, increases of 13 and 31 percent, respectively, over the 1960 figures. A total of 12,667,000 tons of processed materials with a P_2O_5 content of 4,169,000 tons was sold or used during 1961. Land pebble for agricultural uses totaled 7,056,000 tons, 56 percent; for industrial uses, 2,215,000 tons, 17 percent; and for export, 3,396,000 tons, 27 percent. Agricultural uses were divided as follows: 61 percent in the manufacture of ordinary superphosphate, 29 percent in triple superphosphate, and the remaining 10 percent in nitraphosphate manufacture, direct application to the soil, stock and poultry feed, and other fertilizers. For industrial uses, 86 percent went into the manufacture of wet-process phosphoric acid, and the remaining 14 percent was consumed in the production of elemental phosphorus, ferrophosphorous, and phosphoric acid. A total of 396,172 tons of processed material with a

P_2O_5 content of 127,145 tons was both purchased from and sold to mining companies, an interchange common to the industry.

Land-pebble phosphate came from 16 mines operated by 9 companies in Polk and Hillsborough Counties. The following companies, listed in order of output, operated: International Minerals & Chemical Corp. (Achan and Noralyn mines), American Agricultural Chemical Co. (Palmetto, So. Pierce, and Boyette mines), Virginia-Carolina Chemical Corp. (Clear Springs and Homeland mines), American Cyanamid Co. (Orange Park and Sydney mines), W. R. Grace & Co., Davidson Chemical Division (Bonny Lake and Clarke-James mines), Swift & Co. (Varn and Watson mines), Armour Agricultural Chemical Co. (Armour mine), Smith-Douglass Co. Inc. (Tenoroc mine), and New Concept Co. (Green Bay mine). Six of these companies mined over 1 million tons of phosphate each.

Hard-rock phosphate, for use in manufacturing ordinary superphosphates, elemental phosphorus, ferrophosphorous, and phosphoric acid, was mined by only one company, Kibler-Camp Phosphate Enterprise (Section 20 mine), Citrus County.

Soft-rock phosphate came from eight mines, operated by six companies, in four counties. The largest single-mine producer was, as in 1960, Sun Phosphate Co. (Dunnellon mine), Citrus County; the largest producing company, with three mines, was The Loncala Phosphate Co. (Lake City Junction mine, Columbia County; Mona mine, Gilchrist County; and Minehead mine, Marion County). Other producers, in order of output, were Soil Builders, Inc. (Mincoll mine), Kellogg Co. (Kellogg mine), The Camp Phosphate Co. (Hernando mine), and Superior Phosphate Co. (Bar mine), all in Citrus County. Loncala's new Minehead plant and mine operated only during the last half of the year. Camp Phosphate and Superior Phosphate Co. went out of business and only operated during the first 6 months of the year. Superior Phosphate sold its operation to Thompson Sales Co., a fertilizer concern, of Montgomery, Ala. Total marketable production was 41,694 long tons with a P_2O_5 content of 8,431 tons valued at $325,000. Soft rock phosphate was used in stock and poultry feed and for direct application to the soil.

International Minerals & Chemical Corp. continued to be the leading producer of land-pebble phosphate. The company began a $5 million expansion and improvement program at its Florida mines and plants. The improvement program permitted changes in mining plans to increase production, including the purchase of a dragline with a 35-cubic-yard bucket, to be installed at the Achan mine. The big excavator, larger than any the company had been using, was named the "Master Miner" and was expected to be placed in operation in January 1962; it had operator cabs on each side of the machine and operated with 2,200 connected horsepower. Hydraulic transportation at the company Achan and Noralyn mines was described.[4] Production of high-analysis diammonium phosphate began late in the year at International's 120,000-ton-per-year plant at Bonnie. The plant, estimated to cost $3.2 million, produced a material containing 18 percent nitrogen and 46 percent phosphoric acid (P_2O_5). Increasing demand for the material, especially in the Midwest, was responsible for the expansion. The material was to be shipped by rail and by river barge to company-owned storage sites to facilitate delivery to midwestern and southern markets. About midyear the company announced an extensive reclamation program to expand facilities at International Park, near Bartow. International also announced that its technical division would consolidate all research activities at its Skokie, Ill., research center. Previously considerable research had been conducted at the company development laboratory at Mulberry, Fla. Chemical and minerals processing development, including pilot-plant operation and assistance on major plant problems, would continue to be the responsibility of the Mulberry development group. The change to Skokie was designed to increase coordination of research efforts and to establish a closer working relationship between research personnel and the corporate divisions.

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[4] Hardy, Harvey B., Svend A. Canariis, Matthew T. Smith, U. K. Custred, and J. L. Wester. Hydraulic Transportation of Florida Phosphate Matrix. Min. Eng., March 1961, pp. 274–281.

American Agricultural Chemical Co. moved up from the third to the second largest producer of land-pebble phosphate. The company completed construction of a new phosphate washer at its Palmetto operation and installed new equipment.

Virginia-Carolina Chemical Corp., Bartow, which ranked as the second largest producer of land pebble in 1960, dropped to third in 1961. The company's new flotation plant, at the Clear Springs mine in Polk County, was brought on stream and exceeded design capacity. Mining operations continued in the Little-Stuart West property, one of three tracts made available to the company through leasing agreements, formerly with Kentucky Store & Land Co. and later with the trustee for the company employee retirement plan. The mining division's annual capacity to produce calcined phosphate rock was increased by 400,000 tons upon completion of a new 10- by 160-foot rotary kiln at Nichols. In the calcining operation, wet phosphate rock is introduced into a kiln where temperatures exceeding 1,500° F are applied. The process removes organics; bone phosphate of lime content is elevated; and the suitability for chemical processing is improved. The company was the Nation's largest producer of calcined rock. Virginia-Carolina also completed construction of expanded facilities for manufacturing concentrated superphosphate and diammonium phosphate and in view of this expansion the company entered into agreements with Texas International Sulphur Co. and its sulfur-mining subsidiary, Central Minera, S.A., in Mexico. Texas International was to provide Virginia-Carolina with substantial quantities of sulfur over a 10-year period, and Virginia-Carolina was to provide the Mexican company with technical and management assistance.

American Cyanamid Co. was the State's fourth largest producer of land-pebble phosphate. The company in 1960 began a program of reclaiming mined phosphate lands, to be carried on simultaneously with mining. Reclamation was in progress in 1961 at the Sydney and Orange Park mines. Advance planning of phosphate lands before mining, including land contour, in-process moving of dragline, powerlines and pipelines, and other factors such as depth of overburden and availability of tailings materials, was an important facet in reclamation of the lands. Hydraulic transportation at the company Sydney mine was described.[5] Cyanamid announced a multimillion dollar expansion of its Brewster operations to produce an additional 200,000 tons of granular triple superphosphate; expansion of phosphoric acid production capacity to 400,000 tons per year was completed and tied into existing facilities. Near the end of 1961, American Cyanamid Co., New York, was licensed to use a process developed by the Tennessee Valley Authority (TVA) for producing granular diammonium phosphate. The process uses phosphoric acid made by the electric-furnace or wet process in the TVA ammoniator. More than 150 of the TVA-type ammoniators were being used in the United States.

W. R. Grace & Co., Davison Chemical Division, completed extensive modernization and expansion of phosphate rock-mining facilities at its Bonny Lake mine at Ridgewood. These facilities replaced the Pauway No. 4 mine, closed in 1960, which had been operated for 40 years. The company also erected a new dragline at the new operation, with a bucket capacity of 20 cubic yards and a capability of digging to a depth of 115 feet.

Swift & Co. completed and placed in operation its new phosphoric acid plant near yearend. Construction of a new contact sulfuric acid plant was begun at the Agricola, Fla., operation of Swift in September. The new unit, of Leonard-Monsanto design, would supplement the company's two existing acid plants of the same design, and would triple existing sulfuric acid productive capacity. The new unit was expected to be completed in April 1962. Output of the new plant was to be used to treat phosphate rock mined at the site, with the resulting sulfuric acid to be used in producing concentrated phosphate compounds.

Armour Agricultural Chemical Co., Division of Armour & Co., announced the signing of several contracts in connection with its $60 million expansion program. The contracts included a phosphate plant near Fort Meade and a nitrogen plant in an adjoining State. When completed in 1962, these combined facilities would approximately triple the company's production of phosphates and nitrogen. In addition, the company purchased 880 acres of Polk County phosphate land from the Jesuit High School Foundation, Inc., of Tampa for $1.5 million. The purchase consisted of five tracts, 3 miles west of Fort Meade, adjoining Armour's new processing plant under construction.

Smith-Douglass Co., Inc., continued research and reported that the Hollingsworth flotation cell, perfected for use in phosphate processing, also might be adapted to the flotation of other nonmetals, metals, and fuels, including sand, copper, zinc, and coal. Hydraulic transportation at the company Tenoroc mine was described.[6]

New Concept Co. continued operation of its Green Bay property; the company was upgrading tailing materials from a previous phosphate-mining operation through the use of Cannon separators. This was the only known operation of its type in the Florida phosphate field.

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[5] Work cited in footnote 4.
[6] Work cited in footnote 4.

U.S. Phosphoric Products Division, Tennessee Corp., Tampa, announced construction had begun about midyear on a 350-ton-per-day ammonia plant at East Tampa. The plant was to use natural gas as the raw material and the ammonia was to be used to manufacture high-analysis fertilizer. Late in the year the company announced that a new Leonard-Monsanto sulfuric acid unit of 1,200-ton-per-day capacity had been put on stream at Tampa. Most of the output was to be used by the company to make agricultural products.

The TVA,[7] completed at midyear a phosphate-prospecting program begun in Florida in 1955, and was continuing negotiations for the purchase of 737 acres of additional phosphate land. This purchase would bring TVA holdings of Florida phosphate lands to 4,811 acres, containing an estimated 21.4-year's supply of phosphate raw materials. The objective of the program was to assure TVA an adequate supply of phosphate raw materials for its fertilizer program and for munitions in the event of national emergencies. A little under 50 percent of the phosphate used at Muscle Shoals, Ala., was purchased in Florida; the remainder came from TVA mining operations in Tennessee. Furnace charges for producing elemental phosphorous were made of combinations of high-grade Florida Phosphate and the lower Tennessee grades. TVA was constructing a new 25,000-kw rotating electric phosphorous furnace that was expected to provide an improved product for fertilizer. The new furnace was to replace three smaller stationary furnaces.

Sand and Gravel.—Output of sand and gravel declined for the first year since 1958; tonnage decreased 3 percent, but value remained about the same as in 1960. Total output was 6.5 million tons valued at $5.6 million. Sand production decreased 1 percent in quantity, but increased 3 percent in value; gravel decreased 28 percent in quantity and 16 percent in value. Sand and gravel was produced by 45 mines in 25 counties, compared with 43 mines and 12 counties in 1960. Leading sand-producing counties, in order of output, were Polk, Lake, and Putnam; Lake County moved up from third to second. Leading producers in each of these counties were Standard Sand Co. (Standard mine), Polk County; E. R. Jahna Industries, Inc. (Clermont mine), Lake County; and Diamond Interlachen Sand Co. (Interlachen mine), Putnam County. Seventy-seven percent of the sand produced was sold or used as building sand, 10 percent as paving sand, 9 percent as fill sand, and 4 percent for industrial uses, chiefly glass, blast, and filtration uses. Gravel, produced by five mines in four counties, and including Government-and-contractor material, totaled 337,000 tons valued at $553,000. Forty-five percent of the total commercial and Government-and-contractor gravel, combined, was sold or used as building gravel, and 55 percent as paving gravel. Leading gravel producers were Florida Gravel Co. (Chattahooche mine), Gadsden County; and Ward Gravel Co. (Flomaton mine), Escambia County. Ninety-four percent of the sand and gravel was processed by washing, classifying, or other methods, and the remaining 6 percent was unprocessed. Forty-six percent of the material was transported by truck and 54 percent was moved by railroad, compared with 42 and 58 percent in 1960. Thirteen counties reported Government-and-contractor sand and gravel production from 13 mines.

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[7] Tennessee Valley Authority. Annual Report of the Tennessee Valley Authority, for Fiscal Year Ended June 30, 1961. 89 pp.

TABLE 5.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Bay	(1)	(1)	(1)	(1)
Broward	(1)	(1)	137,849	$205,91
Clay	-------	-------	(1)	(1)
Dade	712,387	$530,374	330,473	216,806
Duval	-------	-------	38,848	28,776
Escambia	386,515	356,812	398,705	373,806
Gadsden	222,898	364,145	195,416	354,019
Glades	(1)	(1)	42,000	37,000
Hendry	-------	-------	17,000	13,500
Hillsborough	-------	-------	15,375	31,390
Indian River	-------	-------	17,750	14,200
Jackson	-------	-------	300	219
Lafayette	-------	-------	38,880	21,384
Lake	882,602	585,786	1,075,477	752,837
Leon	78,613	110,545	(1)	(1)
Martin	-------	-------	71,800	68,900
Orange	-------	-------	150,000	111,750
Palm Beach	-------	-------	228	214
Pinellas	-------	-------	10,000	8,500
Polk	3,069,400	2,250,686	2,456,988	1,984,164
Putnam	958,271	832,352	842,758	706,150
St. Lucie	(1)	(1)	(1)	(1)
Sarasota	-------	-------	54,360	80,550
Volusia	(1)	(1)	(1)	(1)
Washington	-------	-------	33,750	25,000
Undistributed	446,157	528,478	602,511	541,765
Total	6,756,943	5,559,178	6,530,468	5,576,846

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

TABLE 6.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	5,054,133	$3,924,689	$0.78	4,760,311	$3,741,937	$0.79
Paving	399,823	377,631	.94	621,684	596,292	.96
Fill	565,825	306,107	.54	540,928	266,696	.49
Glass	(1)	(1)	(1)	90,899	178,973	1.97
Other [2]	265,687	288,054	1.08	170,452	239,564	1.33
Total	6,285,468	4,896,481	.78	6,193,274	5,023,462	.81
Gravel:						
Paving	183,189	329,194	1.80	186,712	364,584	1.95
Structural	288,286	333,503	1.16	150,482	188,800	1.25
Total	471,475	662,697	1.41	337,194	553,384	1.64
Total sand and gravel	6,756,943	5,559,178	.82	6,530,468	5,576,846	.85

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Includes molding, grinding and polishing, blast, filtration, other sands, and uses indicated by footnote 1.

The Standard Sand & Silica Company operation at Davenport was described.[8] The operation consisted of two washing and classifying plants and a large drying and screening plant; up to 450 tons per hour of concrete, mason's sand, and plaster sand could be produced. The company's sand deposits covered more than 1,000 acres; mining was accomplished with two 10-inch dredges.

Staurolite.—Output of staurolite, first included in State mineral production in 1957, declined slightly in 1961 for the first year since production began; tonnage and value were about 1 percent lower than in 1960. E. I. du Pont de Nemours & Co. Inc., Clay County, the only producer in the United States, recovered staurolite as one of the byproducts in concentrating titanium minerals at its Highland and Trail Ridge plants. Staurolite continued to find its biggest use as an alumina and iron hydroxide additive in cement manufacturing.

Stone.—Florida, for the second consecutive year, led the Southeastern States in total stone production and moved up to sixth place in the Nation. Total output was 28.9 million tons valued at $36.3 million, an increase of 1 percent in tonnage, but a decrease of 3 percent in value from 1960. Increased crushed oystershell output was primarily responsible for the overall gain; output increased 103 percent, and value rose 45 percent. Crushed limestone output decreased for the first year since 1952; it declined 1 percent in quantity and 6 percent in value. Crushed limestone used in the manufacture of cement decreased 6 percent in tonnage and 33 percent in value. Dimension limestone production, from one operation, was recorded for the first year since 1959.

Crushed limestone was produced at 83 quarries in 23 counties; 85 percent was sold or used for concrete, roadstone, and screenings, 2 percent for agricultural purposes, 1 percent for railroad ballast, and the remaining 12 percent for other uses. Eight companies in five counties produced crushed limestone for agricultural purposes. Leading counties in crushed stone output, as in 1960, were Dade, Hernando, and Broward; leading producing companies, in order of output, were Florida Rock Products Corp., Hernando County; Seminole Rock Products, Inc., Dade County; Camp Concrete Rock Co., Hernando County; and Ideal Crushed Stone Co., Dade County.

Government-and-contractor crushed limestone was produced by five county highway departments, compared with six in 1960; 213,000 tons of limestone valued at $187,000 was produced. These totals represented decreases of 46 and 39 percent. All of this stone was transported by truck.

Florida ranked third in production of crushed oystershell. It was produced by six companies in five counties, all on leases obtained from the State of Florida. Increased output was attributed to demand by the cement and lime industries. One company produced oystershell for use as poultry grit, and the other five companies produced material for use in concrete, road metal, and screenings. Leading producers, in order of output, were Radcliff Materials, Inc., Walton County; Benton and Company, Inc., Pinellas County; and Edison Shell Co., Lee County. The material was transported as follows: 2.9 million tons by truck, 169,000 tons by waterway, and 15,000 tons by railroad.

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[8] Trauffer, Walter E. Versatile Florida Sand Firm. Pit and Quarry, v. 54, No. 2, August 1961, pp. 94–97.

TABLE 7.—Crushed limestone and oystershell sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roadstone	23,309,376	$30,229,203	$1,30	24,912,267	$30,804,467	$1.24
Agstone	728,340	2,125,907	2.92	666,979	1,950,071	3.75
Railroad ballast	199,341	327,970	1.65	(1)	(1)	(1)
Poultry grit	(1)	(1)	(1)	30,988	457,338	14.76
Stone sand	372,186	412,356	1.11	----------	----------	----------
Other uses [2]	3,019,737	4.323,542	1.43	3,444,395	3,292,883	.96
Total	27,628,980	37,418,978	1.35	29,054,629	36,504,759	1.26

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other uses."
[2] Includes asphalt filler, cement, lime, mortar, and fill uses, and uses indicated by footnote 1.

TABLE 8.—Crushed limestone sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Alachua	1,201,668	$1,030,731	1,254,580	$1,085,110
Broward	4,079,176	5,181,281	4,057,418	5,198,166
Citrus	(1)	(1)	(1)	(1)
Collier	(1)	(1)	592,970	823,203
Columbia	(1)	(1)	(1)	(1)
Dade	7,707,367	9,673,221	7,366,905	8,302,383
Duval	----------	----------	(1)	(1)
Flagler	(1)	(1)	(1)	(1)
Hendry	(1)	(1)	(1)	(1)
Hernando	5,415,406	8,893,350	4,841,868	7,501,328
Indian River	8,066	6,453	16,500	13,200
Lafayette	239,600	209,088	161,000	141,680
Lee	(1)	(1)	(1)	(1)
Levy	414,264	784,152	531,354	866,309
Manatee	(1)	(1)	(1)	(1)
Marion	1,329,792	1,223,071	1,282,318	1,206,943
Monroe	(1)	(1)	281,250	354,375
Palm Beach	(1)	(1)	(1)	(1)
Pasco	(1)	(1)	(1)	(1)
Pinellas	7,350	7,350	----------	----------
St. Johns	(1)	(1)	----------	----------
Sarasota	(1)	(1)	(1)	(1)
Sumter	(1)	(1)	(1)	(1)
Suwannee	(1)	(1)	(1)	(1)
Wakulla	----------	----------	(1)	(1)
Undistributed	5,660,110	7,842,193	5,289,804	7,096,387
Total	26,062,799	34,850,890	25,675,967	32,589,084

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Dimension limestone was produced by one company, Key Marble, Inc., Monroe County, for use as building stone.

R. H. Wright, Inc., Fort Lauderdale, a subsidiary of Houdaille Industries, Buffalo, N.Y., purchased Duval Engineering & Contracting Co., Jacksonville, and three related Duval companies. The related companies were White Shell Corp., an oystershell-dredging firm; Newberry Corp., a crushed limestone producer; and Savannah Bridge Co., Inc. Duval was to be operated as a wholly owned division of R. H. Wright, Inc., and was to be called Duval-Wright Engineering Co.

Coral Aggregates, Inc., opened a new crushed limestone operation in the Miami area, in Dade County, late in the year. The new plant had a capacity of 4,500 tons of aggregate per day. Reserves on a 160-acre tract controlled by the company were estimated at more than 8.5 million tons.

The Brooksville Rock Co. crushed stone plant near Brooksville was described.[9] Heavy-duty scrubbing and rinsing equipment strips out clay contaminants to produce a clean aggregate. A general description of material handling from the quarry to the finished product is included; plant equipment is listed.

Industrial Limerock, Collier County, merged early in the year with three gulf coast construction and land development companies. Naples Supply Co.; Royal Palm Harbor, a real estate development company; and Modern Builders Supply Co., a Sarasota cement products firm. The parent company, to be known as Industrial Limerock, Inc., was to furnish building materials and raw materials for all types of construction.

Vermiculite.—Zonolite Co. exfoliated vermiculite at three plants near Jacksonville, Duval County; Tampa, Hillsborough County; and Boca Raton, Palm Beach County. Total plant output decreased 24 percent in quantity and 22 percent in value below that of 1960. Raw materials for the plants were received from mines in South Carolina, Montana, and South Africa.

METALS

Ferroalloys.—American Agricultural Chemical Co., Pierce, and Virginia-Carolina Chemical Corp., Nichols, produced ferrophosphorous as a byproduct of the electric-furnace process of smelting phosphate rock for making elemental phosphorous. Production increased 28 percent, shipments 34 percent, and value 16 percent compared with 1960. Approximately 92 percent of the ferrophosphorous produced was shipped, 4 percent more than in 1960.

Rare-Earth Metals.—Titanium Alloy Manufacturing Division of National Lead Co., near Jacksonville, recovered monazite as a byproduct of concentrating heavy minerals from sand deposits. Production and shipments increased considerably over 1960, when only a small quantity of monazite was produced and none was shipped.

Titanium Concentrates.—For the sixth consecutive year, Florida ranked second in production of titanium concentrates. Total quantity and value of ilmenite and rutile concentrates decreased. Ilmenite decreased 3 percent in tonnage and 6 percent in value; rutile decreased 16 percent in both tonnage and value.

E. I. du Pont de Nemours & Co., Inc., produced ilmenite from the Highland and Trail Ridge mines, Clay County. Du Pont continued as the leading producer of ilmenite.

Titanium Alloy Manufacturing Division of National Lead Co. (Skinner mine), Duval County, produced ilmenite and rutile from deposits near South Jacksonville. The company which also made shipments of rutile from stocks in the name of Rutile Mining Co. of Florida, was, for the second successive year, the leading producer of rutile. The company also recovered monazite as a byproduct of this mining operation.

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[9] Meschter, Elwood, Scrubbers Whip Limerock Matrix. Rock Products, v. 64, No. 10, October 1961, pp. 100–106.

Florida Minerals Co. (Vero mine), Indian River County, produced ilmenite and rutile from deposits along the east coast.

Zircon.—Florida, for the 22d consecutive year, ranked first in zircon production; the only U.S. production reported in 1961 came from Florida. Total output of three producing companies increased 6 percent in tonnage and value. E. I. du Pont de Nemours & Co., Inc. (Trail Ridge mine), continued to be the largest producer, and Titanium Alloy Manufacturing Division of National Lead Co. (Skinner mine) was the second largest producer. Florida Minerals Co. (Vero mine) recovered zircon as a byproduct of ilmenite and rutile mining. Most of the material was used in refractories and foundries, and as welding flux.

MINERAL FUELS

Natural Gas.—Production of natural gas, all from Humble Oil Company's Sunniland field, Collier County, remained about the same as in 1960; 30 million cubic feet of gas, valued at $5,000 was produced. The gas was all used by Humble in pumping crude petroleum from the field.

Houston Corp., distributor of natural gas in Florida, was given approval by the Federal Power Commission to build 71 miles of pipeline laterals to service new industries; this mileage is in addition to 235 new miles approved in late 1960 for the same purpose. The estimated cost of expanding the company pipeline system throughout the State was given as $23 million. In 1961, Florida was receiving 278 million cubic feet of gas per day; the quantity was to be increased to 371 million cubic feet per day upon completion of the additional pipeline.

Florida Hydrocarbons Co., organized by Houston Corp., was scheduled to begin construction of a new liquid hydrocarbon plant near Brooker, south west of Jacksonville, near the end of the year. The plant, to be completed in mid-1962 at a cost of $7 million, was to have capacity to treat 330 million cubic feet of gas per day. The plant was to recover about 45,000 gallons of gasoline and 90,000 gallons of butane per day.

Peat.—Florida, which ranked second in peat production in 1960, dropped to sixth place in 1961. Total output from five producers in four counties was 25,000 tons valued at $149,000, a decrease of 37 percent in tonnage and 8 percent in value. Orange County was first in production, followed by Hillsborough, Putnam, and Clay Counties; Putnam County ranked first in 1960. Two types of peat, humus and reed-sedge, were produced from bogs and used chiefly for soil improvement purposes.

Petroleum.—Crude petroleum production, all from wells in Humble Oil Co's Sunniland field, Collier County, increased 1 percent in output, but it decreased 2 percent in value from 1960, based on preliminary data. Cumulative production to January 1, 1962, totaled 6,852,620 barrels of oil.

Gulf Oil Co. and California Oil Co. made their third unsuccessful joint effort to find oil on a block of 22 leases, covering 132,480 acres, in an area about 40 miles west of Key West in the Marquesas Keys. The well, the Marquesas No. 1 in Block 46, was drilled to 7,800 feet and abandoned. Gulf Oil Co. had drilled seven dry holes in the Florida Keys area.

The California Co. began drilling a new well in another test of Florida waters in the Boca Grande Pass area, 25 miles northeast of Fort Myers. The well, projected to 12,000 feet, had been drilled below 5,000 feet in early October. The well is 4 miles northeast of an earlier dry hole drilled by California, on a tract held by Coastal Petroleum Co.

Cabinet trustees of the Internal Improvement Fund of the State of Florida did not renew leases on nearly 2 million acres of Monroe and Collier County oil lands held by Commonwealth Oil Co. The acreage was obtained in 1943, and 17 new leases were granted in 1951. Leases on the acreage were to be opened for competitive bids by other companies. In another action by the Internal Improvement Fund, Coastal Petroleum Corp., a large leaseholder of State lands, was advised by the State Attorney General that it must get permission from private landowners or from the State to explore for minerals on lands inside bulkhead lines, whether there was a formal bulkhead line around the area or not; areas interpreted were those that were filled or unfilled, and those adjacent or riparian to private uplands.

National Bulk Carriers, Inc., an ocean-shipping concern, announced late in the year that it was seeking authority to build a $40 million petroleum refinery on a 200-acre site near Homestead. The proposed refinery would have capacity to convert 50,000 barrels of crude oil a day into petroleum products. After approval is obtained, about 2 years would be required for construction of the plant. The company also planned to establish a seaport at Homestead on a 2-mile-square area of land along the bayfront due east of Homestead Air Force Base. Included in the seaport planning was a channel 5 miles long and 30 feet deep to serve oceangoing freighters.

REVIEW BY COUNTIES

Mineral production was recorded in 44 of the State's 67 counties, 3 more than in 1960. Polk, Dade, and Hillsborough, in order of value, were again the three leading mineral-producing counties, with Polk County furnishing 47 percent of the total mineral production value. The next most important mineral-producing counties, in order of value, were Clay, Hernando, Gadsden, Flagler, and Broward, each having a total value of more than $5 million, and Gulf, Walton, Duval, Taylor, Citrus, and Sumter Counties, having values of more than $2 million, each. These 14 counties accounted for 94 percent of the State total mineral production value. Crushed limestone was produced in 23 counties; sand and gravel in 25; phosphate rock in 6; crushed oystershell and lime in 5; clays and peat in 4; and titanium concentrates, cement, and zircon in 3. Perlite and vermiculite were processed in three counties, each.

Alachua.—Total value of mineral production increased 5 percent over 1960. The following companies, listed in order of output, crushed limestone: Ocala Lime Rock Corp. (Haile quarry), Duval-

Wright Engineering Co., formerly the Newberry Corp. (Haile quarry), Williston Shell Rock Co. (Buda quarry), Limestone Products, Inc. (Haile quarry), W & M Construction Co. (Norfleet quarry), and Peacock Lime Rock Co. (Peacock quarry). The material was used primarily for concrete, roadstone, and screenings, and for agricultural purposes. Eighty percent of the tonnage was transported by railroad, and 20 percent was moved by truck.

TABLE 9.—Value of mineral production in Florida, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Alachua	$1,030,731	$1,085,110	Limestone.
Bay	(2)	(2)	Sand and gravel.
Broward	(2)	5,404,115	Limestone, sand and gravel.
Citrus	2,522,756	2,098,109	Limestone, phosphate rock, miscellaneous clay.
Clay	(2)	(2)	Ilmenite, zircon, staurolite, sand and gravel, miscellaneous clay, peat.
Collier	(2)	(2)	Crude petroleum, limestone, natural gas.
Columbia	(2)	(2)	Phosphate rock, limestone.
Dade	23,642,909	(2)	Cement, limestone, lime, sand and gravel.
Duval	(2)	(2)	Rutile, ilmenite, zircon, oystershell, monazite, limestone, sand and gravel.
Escambia	356,812	373,806	Sand and gravel.
Flagler	(2)	(2)	Cement, limestone.
Gadsden	6,727,050	(2)	Fuller's earth, sand and gravel, miscellaneous clay.
Gilchrist	(2)	(2)	Phosphate rock.
Glades	(2)	37,000	Sand and gravel.
Gulf	(2)	(2)	Magnesium compounds, lime.
Hendry	(2)	(2)	Limestone, sand and gravel.
Hernando	8,893,350	(2)	Limestone, lime.
Hillsborough	20,798,784	19,925,715	Cement, phosphate rock, peat, sand and gravel.
Indian River	(2)	(2)	Rutile, zircon, ilmenite, sand and gravel, limestone.
Jackson	------	219	Sand and gravel.
Lafayette	209,088	163,064	Limestone, sand and gravel.
Lake	585,786	752,837	Sand and gravel.
Lee	(2)	(2)	Limestone, oystershell.
Leon	110,545	(2)	Sand and gravel.
Levy	784,152	866,309	Limestone.
Manatee	(2)	(2)	Limestone, oystershell.
Marion	(2)	(2)	Limestone, lime, phosphate rock.
Martin	------	68,900	Sand and gravel.
Monroe	(2)	(2)	Limestone, gem stones.
Orange	(2)	(2)	Sand and gravel, peat.
Palm Beach	(2)	(2)	Limestone, sand and gravel.
Pasco	(2)	(2)	Limestone.
Pinellas	(2)	(2)	Oystershell, sand and gravel.
Polk	76,812,386	88,933,410	Phosphate rock, sand and gravel.
Putnam	(2)	(2)	Sand and gravel, kaolin, peat.
St. Johns	(2)	------	
St. Lucie	(2)	(2)	Sand and gravel.
Sarasota	(2)	(2)	Limestone, sand and gravel.
Sumter	(2)	(2)	Limestone.
Suwannee	(2)	(2)	Do.
Taylor	1,940,000	2,160,000	Lime.
Volusia	(2)	(2)	Sand and gravel.
Wakulla	------	(2)	Limestone.
Walton	(2)	(2)	Oystershell.
Washington	------	25,000	Sand and gravel.
Undistributed	32,508,651	69,039,406	
Total	176,923,000	190,933,000	

[1] The following counties are not listed because no production was reported: Baker, Bradford, Brevard, Calhoun, Charlotte, De Soto, Dixie, Franklin, Hamilton, Hardee, Highlands, Holmes, Jefferson, Liberty, Madison, Nassau, Okaloosa, Okeechobee, Osceola, Santa Rosa, Seminole, and Union.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Bay.—Taylor Sand Co. (Taylor mine) and Cato Sand Co. (Mill Bayou mine), produced building and paving sand, all of which was transported by truck.

Broward.—Broward County ranked eighth in value of mineral production. The county was third in crushed stone output; it was exceeded only by Dade and Hernando Counties. Crushed stone production increased 3 percent in quantity and value. Sand and gravel output increased 15 percent in tonnage, but it decreased 19 percent in value. Eleven companies crushed limestone at 14 quarries, 1 more than operated in 1960. The three leading quarries, listed in order of output, were Hollywood Quarries, Inc., (Broward County quarry), Maule Industries, Inc. (Prospect quarry), and R. H. Wright, Inc. (Green quarry and crushing plant). Meekins, Inc. operated three quarries (Oakland Park No. 5, Hollywood No. 1, and Deerfield No. 4); R. H. Wright operated two quarries (Green and Wright). Most of the crushed limestone was used for concrete, roadstone, and screenings, and was transported by truck. Florida Silica Sand Co., Inc., (Pegram mine) and Davie Sand Corp. (Fort Lauderdale mine) produced sand for building and fill purposes, respectively. Broward County Highway Department produced 18,000 tons of sand valued at $11,000 for use in highway maintenance.

Citrus.—Citrus County, which ranked ninth in value of mineral production in 1960, dropped to twelfth place in 1961. Kibler-Camp Phosphate Enterprise (Enterprise mine), the only hard-rock phosphate producer in the State, mined 81,000 tons of phosphate valued at $746,000, increases of 5 and 11 percent over the 1960 figures.

Soft-rock phosphate was produced at five mines by five companies; total output was lower than in 1960. Producers, listed in order of output, were Sun Phosphate Co. (Dunnellon mine), the largest soft-rock producer in the State, Soil Builders, Inc. (Mincoll mine), Kellogg Co. (Kellogg mine), Camp Phosphate Co. (Hernando mine), and Superior Phosphate Co. (Bar mine). Camp Phosphate was reportedly out of business at yearend. Superior Phosphate sold out to Thompson Sales Co., a fertilizer concern, of Montgomery, Ala., about midyear. General Portland Cement Co. (Citrus County quarry and mine) crushed limestone and mined miscellaneous clay for use in manufacturing cement. Colitz Mining Co. (Blue Water quarry) crushed limestone for concrete, roadstone, and screenings. Crystal River Quarries (Crystal River quarry) and Middleton Mining Co., Inc., produced limestone for agricultural purposes. Middleton Mining reported production for the first year.

Clay.—Clay County moved up from fifth to fourth in value of mineral production. E. I. du Pont de Nemours & Co., Inc. (Trail Ridge and Highland mines), produced ilmenite and byproduct zircon and staurolite. King Concrete Sand Co. (Keystone Heights mine) and All-Florida Sand Co. (Interlachen mine) produced building and paving sand. Solite Corp., a subsidiary of Southern Lightweight Aggregates Corp., Richmond, Va., produced miscellaneous clay at the Russell mine for making lightweight aggregate, utilized in structural concrete and masonry. The company was in its third year of operation.

Tomes Peat Humus, Keystone Heights, produced humus peat for use in soil conditioning.

Collier.—Collier County was the only county reporting crude petroleum and natural gas production. Petroleum production increased slightly, and natural gas output remained about the same as in 1960.

Industrial Limerock, Inc. (Sunniland quarry), Sunniland Limerock Co. (Sunniland quarry), and Naples Limerock Co. (Belle Meade quarry), a new producer reporting for the first year, crushed limestone for concrete, roadstone, and screenings. Total output was greater than in 1960. Sixty-one percent of the stone was transported by truck and 31 percent was moved by railroad.

Columbia.—Loncala Phosphate Co. (Fort White mines) mined soft-rock phosphate, which was processed at its Lake City Junction plant; tonnage and value were lower than in 1960. Limestone Products, Inc. (Columbia City quarry), operating for the second year, crushed limestone for concrete, roadstone, and screenings; tonnage and value declined.

Dade.—For the third consecutive year, Dade County ranked second in value of mineral production. The county led, for the fourth consecutive year, in crushed stone output; 20 quarries were active, compared with 18 in 1960. The three leading producers were Seminole Rock Products Co. (Medley quarry), Ideal Crushed Stone Co. (Dade County quarry), and Oolite Crushed Stone Co. (Richmond quarry). Total stone output was 7.4 million tons valued at $8.3 million. Seventy-four percent of the stone was transported by truck, 24 percent by railroad, and the remainder by waterway. Lehigh Cement Co. (Miami mill) and General Portland Cement Co. (Everglades mill) produced masonry and portland cements. Tonnage and value were lower than in 1960. Sample Rock Co. (Opa Locka mine) produced fill sand; Des Rochers Sand Co., Inc. (Cape Florida mine), paving sand; Golden Brown Soil Co. (Miami mine), sand for fill and lawn dressing and paving gravel; and Dade County Highway Department, sand for road maintenance. The city of Miami (Hialeah limekiln) produced 27,000 tons of quicklime valued at $281,000, an increase of 17 percent in tonnage and 15 percent in value over the 1960 figure. The lime was used as a water softening and purification agent in the municipal waterplant. Tennessee Products & Chemical Corp. and Perlite, Inc. (Hialeah plant), processed perlite from Western States for use in concrete, building plaster, and soil conditioning.

Duval.—Duval County, for the first year, was not among the leading 10 counties in value of mineral production. Commodities produced were ilmenite, rutile, monazite, zircon, sand and gravel, crushed stone, and oystershell. Titanium Alloy Manufacturing Division of National Lead Co. (Skinner mine) produced ilmenite, rutile, and zircon; Rutile Mining Co. of Florida, also a National Lead subsidiary, produced and shipped a small tonnage of rutile from its Jacksonville mine. Southside Sand Co. produced building sand; High Springs Limerock Corp. crushed limestone for concrete, roadstone, and screenings; and White Shell Corp (White Shell plant) produced 31,000 tons of crushed oystershell valued at $457,000, less than in 1960. United States Gypsum Co. calcined gypsum at its plant near Jacksonville for use in manufacturing building products.

Escambia.—Sand and gravel was produced by five operations, compared with three in 1960; tonnage and value increased appreciably. Ward Gravel Co. (Century mine), the largest producer in the county, mined 153,000 tons of sand and gravel valued at $149,000; Escambia County Highway Department mined 119,000 tons of sand and gravel valued at $105,000; Clark Sand Co. (Pensacola mine) produced building sand; Campbell Sand & Gravel Co. (Flomaton mine) produced sand and gravel; and Boone Construction Co., a new operation reporting for the first year, mined a small tonnage of sand for building purposes.

Flagler.—Flagler County ranked seventh in value of mineral production, dropping from sixth place in 1960. Lehigh Portland Cement Co. (Bunnell mill and quarries) produced masonry and portland cements. The company, only mineral producer in the county, crushed limestone from its Coquina quarry, for use in the manufacture of cements.

Gadsden.—Florida and Gadsden County, for the fourth consecutive year, ranked first in the Nation in output of fuller's earth. Fuller's earth production established a record high in both tonnage and value. Producers, in order of output, were Minerals & Chemicals Philipp Corp. (La Camelia mine), Floridin Co., Inc. (Quincy mine), and Magnet Cove Barium Corp. (Havana mine). Florida Gravel Co. (Chattahoochee mine) mined 195,000 tons of sand and gravel valued at $354,000. Tonnage and value were slightly lower than in 1960. Appalachee Correctional Institute (Chattahoochee mine) produced miscellaneous clay, on a small scale, for the manufacture of building brick.

Gilchrist.—Loncala Phosphate Co., the only mineral producer in the county reporting production, mined and processed soft-rock phosphate. The material was used principally in stock and poultry feed, and for direct application to the soil.

Glades.—Caloosa Industries, Inc. (Ortona mine) mined 42,000 tons of building sand valued at $37,000. This was the company's second year of operation, and its output represented the only mineral production reported in the county. All of the sand was transported by truck.

Gulf.—Gulf County ranked ninth in the State in mineral production value, making its first appearance in the top 10 producing counties. Michigan Chemical Corp. (Port Saint Joe plant) recovered magnesium compounds from sea water and more than trebled its 1960 output. Caustic-calcined and refractory magnesia sold or used was supplied to the refractories and insulating board industries.

Hendry.—Caloosa Rock Corp. (La Belle quarry) crushed limestone for concrete aggregate, roadstone, and screenings. Hendry County Highway Department produced sand and gravel for use in its highway maintenance program. All of the output of both producers was transported by truck.

Hernando.—Hernando County dropped from fourth to fifth place in value of mineral production. The county, as in 1960, ranked second in crushed stone output; its production was exceeded only by that of Dade County. The county produced 4.8 million tons of crushed limestone valued at $7.5 million, a decrease of 11 percent in tonnage and 16 percent in value. Seven companies crushed limestone at seven quarries; Florida Rock Products Co. (Diamond Hill quarry) and Camp Concrete Rock Co. (Gay quarry), two of the three leading stone producers in the State, crushed limestone for use in concrete, roadstone, and screenings. Other producers, in order of output, were

Lansing Rock Co. (Brooksville quarry), Aripeka Limerock Co. (Aripeka quarry), William P. McDonald Corp. of Florida (Conrock quarry), Hernando Limerock Co., and Brooksville Rock Co., Inc. (Broco quarry). The stone was transported 58 percent by railroad and 42 percent by truck.

Chemical Lime, Inc., completed and placed into operation, near yearend, its new $2.5 million lime plant. The plant, owned jointly by Camp Concrete Rock Co., Ocala, and Lee Lime, Inc., Lee, Mass., used the fluid-bed method of making lime in an upright kiln. The plant produced only a small tonnage of lime in 1961; however, it was estimated that ouput would be about 200 tons per day when the plant is in full operation.

Hillsborough.—Hillsborough County, for the third consecutive year, ranked third in value of mineral production. American Cyanamid Co. (Sydney mine) and American Agricultural Chemical Co. (Boyette mine) produced land-pebble phosphate. General Portland Cement Co. produced masonry and portland cements at its Tampa mill. Edgar Plastic Kaolin Co., reporting production for the first year from its new sand operation, produced 15,000 tons of industrial sand valued at $31,000.

A. J. Stearns, Seffner, and F. E. Stearns Peat, Valrico, produced humus peat for soil conditioning and improvement. The county ranked second in peat output.

Indian River.—Florida Minerals Co. (Vero mine) produced ilmenite, rutile, and zircon from beach sands. Indian River County Highway Department crushed limestone and produced sand for use in highway maintenance; this was the first year that sand production had been reported. Airlite Processing Corp. of Florida expanded crude perlite from Western States at its processing plant near Vero Beach.

Jackson.—Jackson County Highway Department mined a small quantity of sand for use in roads. This was the first year that any mineral production has been reported in the county.

Lafayette.—Williston Shell Rock Co. (Chauncey and Dell Quarries) crushed limestone for concrete, roadstone, and screenings; output from both operations was 161,000 tons valued at $142,000. The Lafayette County Highway Department mined 39,000 tons of sand valued at $21,000 for use in highway maintenance.

Lake.—Five companies mined building sand at five mines. Producers, in order of output, were E. R. Jahna Industries, Inc. (Clermont mine), Eustis Sand Co. (Eustis mine), Silver Lake Estates (Leesburg mine), Central Sand Co. (Tavares mine), which went out of business during late 1961, and Oakland Sand & Mineral Corp. (Clermont mine), reporting for the first year. All of the material was processed, and the majority of the tonnage was transported by truck. The county ranked second in sand and gravel output; its production was exceeded only by that of Polk County.

Lee.—West Coast Rock Co. (Ft. Myers quarry) crushed limestone for use in concrete, roadstone, and screenings; all of the stone was transported by truck. Oystershell was dredged by two companies operating on separate leases from the State of Florida. Edison Shell Co. and Fort Myers Shell Co. were the only two companies reporting for the year, compared with three in 1960.

Leon.—Johnson Sand Co. (Norfleet mine) and Middle Florida Sand Co. (Tallahassee mine) produced building sand. All of the material was processed and transported by truck.

Levy.—Four companies crushed limestone for use in concrete, roadstone, and screenings, and for agricultural purposes. Total output increased, compared with the figures for 1960, when a sharp decrease in tonnage was experienced. Producers, listed in order of output, were Connell & Shultz (Williston quarry), United Limerock Co. (No. 2 Williston quarry), Dixie Lime & Stone Co. (Lebanon No. 4 quarry), and Ralph Swiney (Miller quarry). The stone was transported 56 percent by truck and 44 percent by railroad.

Manatee.—Southern Dolomite Co. (Palmetto quarry) crushed limestone for agricultural purposes and transported the material by truck and railroad. Bradenton Dredging & Shell Co., operating on two State of Florida leases, dredged and crushed oystershell for use in concrete and roadstone.

Marion.—Soft-rock phosphate was produced in the county for the first year; Loncala Phosphate Co. established its new Minehead plant and processed soft-rock phosphate from mines in the county. Dixie Lime & Stone Co. (Ocala No. 1 Limekiln), formerly Dixie Lime Products Co., produced quicklime and hydrated lime for building and chemical purposes. Crushed limestone was produced by four commercial operations and one Government-and-contractor producer. Producers, listed in order of output, were Dixie Lime & Stone Co. (Kendrick No. 3 quarry), Ocala Limerock Co. (No. 7 Kendrick quarry), and Cummer Lime & Manufacturing Co. (Kendrick and Martin quarries). The Marion County Highway Department crushed limestone for use in roads.

Martin.—The Martin County Highway Department, reporting for the first year, produced 72,000 tons of sand valued at $69,000 for use in highway maintenance.

Monroe.—Charley Toppino & Sons, Inc. (Stock Island quarry), crushed limestone for use in concrete and for fill purposes; 281,000 tons of stone valued at $354,000 was produced. All of the stone was transported by truck. Key Marble, Inc., the only dimension limestone producer in the State, reported production for the first year since 1959. All of the stone was transported by truck. White Mountain Minerals Co. reported a small production of gem stone material.

Orange.—Orange County for the first year ranked first in peat production. Daetwyler Peat Co., Orlando, produced reed-sedge peat for soil improvement. Orange County Highway Department, reporting for the first time, produced 150,000 tons of sand valued at $112,000. All of the material was transported by truck and was used in the county road program.

Palm Beach.—Belle Glade Rock Co. (Belle Glade quarry) crushed limestone for concrete, roadstone, and screenings. Palm Beach County Highway Department crushed 130,000 tons of limestone valued at $117,000, and produced a small tonnage of sand for use in its road program. Sand production was reported for the first year.

Pasco.—Port Richey Mining Corp. (Hudson quarry), in operation for the second year, crushed 122,000 tons of limestone valued at $153,000 for concrete, roadstone, and screenings. Camp Concrete Rock

Co. (Ivy quarry) crushed a small quantity of limestone for the same purposes. All of the stone was transported by truck.

Pinellas.—Benton & Co., Inc. (Lease No. 460), dredged and crushed oystershell for use in concrete and roadstone. Pinellas County Highway Department mined 10,000 tons of sand valued at $8,500 for use in its road program.

Polk.—Polk County, the center of land-pebble phosphate production in the State, again was first in mineral production value, continuing a trend begun in 1956. The county furnished 47 percent of the total State value, compared with 43 percent in 1960, and set new records in phosphate rock tonnage and value. Sand and gravel production continued at a high level, and the county led the State in output of this commodity. Marketable land-pebble phosphate output totaled 12.5 million tons valued at $87 million, an increase of 14 percent in tonnage and 17 percent in value over the 1960 figures. The leading producers, in order of output, were International Minerals & Chemical Co. (Achan and Noralyn mines), American Agricultural Chemical Co. (Palmetto and So. Pierce mines), Virginia-Carolina Chemical Corp. (Clear Springs and Homeland mines), and American Cyanamid Co. (Orange Park mine). Other companies operating were W. R. Grace and Co., Davison Chemical Division (Bonny Lake and Clarke-James mines), Swift & Co. (Varn and Watson mines), Armour Agricultural Chemical Co. (Armour mine), Smith-Douglass Co., Inc. (Tenoroc mine), and New Concept Co. (Green Bay mine).

Sand output came from 10 mines; 2.5 million tons of sand valued at $2 million was produced, a considerable decrease in both tonnage and value from the 1960 figures. The three leading producers were Standard Sand Co. (Standard mine), Oak Ridge Sand Co. (Achan mine), and Mammoth Sand Co. (Lake Wales mine). Most of the sand was used for building, paving, and industrial uses. Ninety-one percent of the sand was transported by railroad, and 9 percent was shipped by truck.

Putnam.—Putnam County ranked third in sand and gravel and peat output. Seven mines produced 843,000 tons of sand valued at $706,000, decreases of 12 and 14 percent from the 1960 figures. Leading producers, in order of output, were Diamond Interlachen Sand Co. (Interlachen mine), Southern Materials Co. of Florida (Putnam Hall mine), and Keuka Sand Co., Inc. (Putnam County mine); all produced building sand. Edgar Plastic Kaolin Co. (Edgar mine), the only industrial sand producer reporting, also mined building sand. Seventy-one percent of the material was transported by railroad, and 29 percent was shipped by truck. Edgar Plastic Kaolin Co. (Edgar mine) and United Clay Mines Corp. (No. 4 mine) produced kaolin clay for use in pottery, stoneware, floor and wall tile, and clay crucibles.

Traxler's Peat Co. was the only peat producer. The company produced humus peat for use as a soil conditioner.

St. Lucie.—Fort Pierce Sand & Material, Inc. (Ft. Pierce mine) mined paving sand. None of the material was processed, and all was transported by truck.

Sarasota.—Florida Dolomite Co. (Florida Dolomite quarry) crushed limestone for agricultural purposes. West Coast Rock Co., reporting for the first year, crushed limestone for use in concrete, roadstone, and screenings. Sarasota County Highway Department, also reporting for the first year, mined 54,000 tons of sand and gravel valued at $81,000.

Sumter.—Dixie Lime & Stone Co. (Sumterville quarry), formerly Quality Lime Products, Inc., Nobleton Rock Co. (Nobleton quarry), and Florida Superior Rock Corp. (Wade quarry) crushed limestone for concrete, roadstone, and screenings. Fifty-three percent of the stone was transported by truck, and 47 percent was shipped by railroad.

Suwannee.—Florida Rock Products Corp. (Suwannee quarry and Live Oak quarry) and Suwannee Dolomite & Lime Co. (Live Oak quarry) crushed limestone for concrete, roadstone, and screenings, and for agricultural purposes, respectively. Sixty-six percent of the material was transported by railroad, and 34 percent was moved by truck.

Taylor.—Buckeye Cellulose Corp. (Foley Limekiln) produced 120,000 tons of quicklime valued at $2 million. The lime was used in the company paper plant for water purification and causticizing.

Volusia.—White Sand & Materials Co. (New Smyrna Beach mine) and Houser Concrete Co. (Deland mine) produced a small tonnage of building sand. Volusia County Highway Department, reporting for the first year, mined 51,000 tons of paving sand valued at $51,000 for use in its road program.

Wakulla.—W. R. Taff, reporting for the first year, crushed a small tonnage of limestone for use in concrete, roadstone, and screenings.

Walton.—Walton County was the leading oystershell-producing county. Radcliff Materials, Inc., Mobile, Ala., dredged one of the largest tonnages, from a State lease, in the State's history of oystershell production. This company was the only mineral producer in the county.

Washington.—Miller & Jerkins (Wausau mine) produced 34,000 tons of building sand valued at $25,000. Production from the county was reported for the first year.

The Mineral Industry of Georgia

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Georgia.

By James L. Vallely[1] and Garland Peyton[2]

⁂

THE LONG record-breaking trend of Georgia mineral production continued in 1961. Substantial increases in the value of cement, clays, and stone produced and smaller increases in bauxite and iron ore, more than offset decreases in manganese, mica, and peat. Coal, sand and gravel, and talc production values changed little from those of 1960.

Clays comprised 44 percent of total State production values; stone, 40 percent; sand and gravel, 3 percent; other nonmetals, 11 percent; and coal, peat, and metals, less than 2 percent.

Among the States, Georgia ranked first in output of kaolin, second in fuller's earth, third in stone, and fourth in barite. In stone production, Georgia was first in dimension granite, crushed marble, and crushed slate and second in dimension marble and crushed granite.

TABLE 1.—Mineral production in Georgia[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value, (thousands)
Barite....thousand short tons..	(2)	(2)	107	$2,046
Clays....do....	3,519	$40,160	3,569	42,025
Coal....do....	4	21	4	22
Feldspar....thousand long tons..	(2)	(2)	31	692
Gem stones....	(3)	(4)	(3)	(4)
Iron ore (usable)....thousand long tons, gross weight..	128	613	[5] 162	[5] 835
Mica, sheet....pounds..	10,218	89	349	3
Peat....short tons..	6,904	73	1,032	(2)
Sand and gravel....thousand short tons..	3,338	3,047	3,150	3,049
Stone....do....	14,297	37,033	15,854	38,077
Talc and soapstone....short tons..	40,200	88	47,950	98
Value of items that cannot be disclosed: Bauxite, cement, iron oxide pigments (1960), manganiferous ore, mica (scrap), and values indicated by footnote 2....	----	11,181	----	9,454
Total Georgia[6]....	----	91,203	----	95,256

[1] Production as measured by mine shipments, sales or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Weight not recorded.
[4] Less than $500.
[5] Includes crude iron oxide pigments.
[6] Total adjusted to eliminate duplicating value of clays and stone.

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[2] Director, Geological Survey of Georgia, Atlanta, Ga.

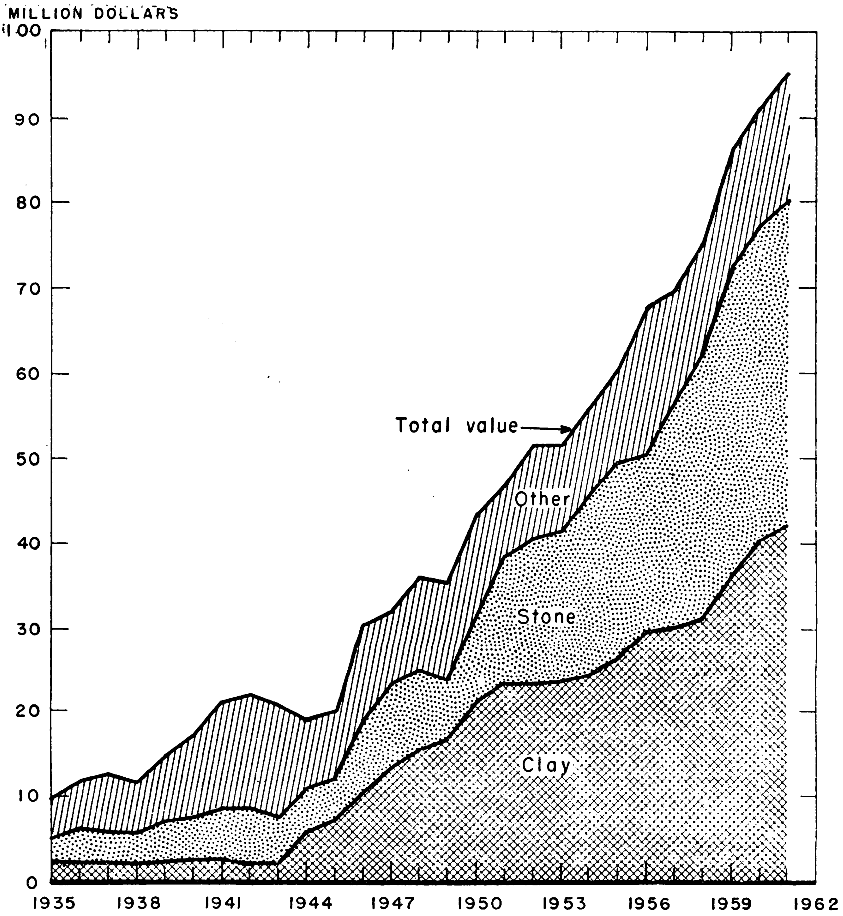

FIGURE 1.—Value of clays and stone, and total value of mineral production in Georgia, 1935–61.

Employment and Injuries.—Employment figures as given in table 2 are not exactly comparable because 1960 figures exclude office workers, and figures for 1961 are preliminary. According to 1961 data, employment in the mineral industries was 5 percent higher than in 1960. Total man-hours worked increased from 15.7 to 16.5 million, and the number of men working daily increased from 7,232 to 7,677, with active days reduced from 270 to 268. Employment in metal and nonmetal mines and mills increased 8 percent, and in sand and gravel mines, 25 percent. Quarries and mills employment was little changed, and coal mine employment decreased 70 percent. The number of active operations declined from 205 to 200.

Only one fatal accident (nonmetal mines and mills) was recorded, compared with 4 (3 in quarries and mills and 1 in sand and gravel mines) in 1960. The number of nonfatal accidents declined from 424 to 292, and the overall injury-frequency rate from 27 to 18 per million man-hours. No injuries had been recorded in coal and metal mines for 3 years.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operations	Men working daily	Average active days	Manhours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960: [1]							
Nonmetal mines and mills	71	3,747	279	8,405,972	----------	213	25
Quarries and mills	72	3,090	264	6,518,527	3	200	31
Sand and gravel mines	40	294	268	630,232	1	11	19
Metal mines and mills	20	89	117	82,998	----------	----------	----------
Coal mines	2	12	190	14,886	----------	----------	----------
Total	205	7,232	270	15,652,615	4	424	27
1961: [2]							
Nonmetal mines and mills	69	4,115	275	9,048,058	1	162	18
Quarries and mills	75	3,111	262	6,531,894	----------	118	18
Sand and gravel mines	35	356	276	787,385	----------	12	15
Metal mines and mills	19	87	129	90,051	----------	----------	----------
Coal mines	2	8	69	4,426	----------	----------	----------
Total	200	7,677	268	16,461,814	1	292	18

[1] Excludes officeworkers.
[2] Preliminary figures.

Trends and Developments.—Among the many developments in the State mineral industry in 1961 were the following: Construction was started at Bolton, near Atlanta, by Southern Cement Co., a Division of Martin Marietta Corp., on a new 1.5 million-barrel cement plant to cost $22.5 million. Atlantic Cement Co. announced plans to build a $2 million bulk-cement storage and distribution center at the Port of Savannah. Minerals & Chemicals Philipp Corp. began constructing a new $2 million ultraflotation plant at McIntyre to improve the quality of kaolin by removing titaniferous impurities.[3] Georgia-Carolina Brick & Tile Co. completed a $1 million expansion program at Augusta to increase production by 36 million brick. Smaller plant expansions[4] reported were by American Industrial Clays, Sandersville; Southern Clays, Inc., Gordon; and United Clay Mines Corp., Sandersville. Texas Gulf Sulfur Co. completed a $400,000 molten sulfur facility at Savannah, and Knox Glass, Inc., completed a $5 million glass-container plant at Forest Park.

Legislation and Government Programs.—A cooperative study by the Georgia Department of Commerce and the Federal Bureau of Mines on brown iron ore resources of Quitman County was in progress during 1961. A Bureau of Mines publication[5] described a process and equipment for grinding kaolin, and the Georgia Department of Mines, Mining and Geology described mineral occurrences.[6]

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[3] E&MJ Metal & Mineral Markets, v. 32, No. 43, Oct. 26, 1961, p. 4. Chemical Engineering, v. 68, No. 23, Nov. 13, 1961, p. 103.

[4] Georgia Department of Commerce. Quarterly Report. V. 2, No. 1, January 1962, pp. 4–6, 8, 10.

[5] Feld, I. L., T. N. McVay, H. L. Gilmore, and B. H. Clemmons. Paper-Coating Clay From Coarse Georgia Kaolins by a New Attrition-Grinding Process. BuMines Rept. of Inv. 5697, 1961, 20 pp.

[6] Georgia Mineral Newsletter. Peat Deposits of Georgia. V. 14, No. 1, spring 1961, pp. 1–21. Geology of Iron Ore Deposits of the Perry Quadrangle, Georgia. V. 14, No. 4, winter 1961, pp. 83–90.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Primary barite production, all from Bartow County, increased in tonnage and value; however, the percentage increase in value was lower, as average sales value decreased from $20.10 to $19.14 per ton. Crushed barite was shipped and used principally for barium chemicals and well drilling mud; ground barite for rubber and paint filler and well drilling mud.

Cement.—Shipments of masonry and portland cements both were higher than in 1960. Total shipments were 11 percent and 9 percent higher, respectively, in quantity and value. Out-of-State shipments were made principally to Florida, with smaller tonnages to Alabama, Mississippi, North Carolina, and South Carolina. Marquette Cement Manufacturing Co. produced portland and masonry cements at Rockmart, and Penn-Dixie Cement Corp. manufactured portland cement at Clinchfield. Southern Cement Co., a Division of Martin Marietta Corp., began construction of a new 1.5 million-barrel cement plant near Atlanta. Atlantic Cement Co. acquired a site at the Port of Savannah for a bulk storage and distribution center.

Clays.—Clay ranked first in value of mineral production and accounted for 44 percent of the State total, unchanged from 1960. Kaolin and miscellaneous clay outputs were only slightly higher than in 1960, each increasing 1 percent; value, however, was up 5 for kaolin and 4 percent for miscellaneous clay. Fuller's earth output rose 7 percent in tonnage and 6 percent in value.

TABLE 3.—Kaolin and fuller's earth sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Baldwin	(1)	(1)	(1)	(1)
Decatur	(1)	(1)	(1)	(1)
Floyd	(1)	(1)	(1)	(1)
Grady	(1)	(1)	(1)	(1)
Jefferson	17,325	$300,242	19,100	$362,327
Macon	(1)	(1)	(1)	(1)
Meriwether	(1)	(1)	---	---
Richmond	82,241	614,505	81,029	641,838
Sumter	(1)	(1)	(1)	(1)
Thomas	(1)	(1)	(1)	(1)
Twiggs	1,072,215	21,087,151	1,089,253	22,335,073
Washington	574,113	10,808,208	666,636	13,109,268
Wilkinson	305,684	5,382,449	(1)	(1)
Other counties	163,348	1,406,751	392,110	4,995,042
Total	2,214,926	39,599,306	2,248,128	41,443,548

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other counties."

TABLE 4.—Kaolin sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Pottery and stoneware:						
Whiteware	66,005	$1,289,382	$19.53	80,563	$1,531,428	$19.01
Art pottery, etc	9,096	143,438	15.77	(1)	(1)	(1)
Floor and wall tile	15,915	233,564	14.68	8,927	145,996	16.35
Refractories:						
Firebrick and block	224,071	1,550,171	6.92	193,834	1,343,516	6.93
Fire-clay mortar	1,200	5,580	4.65	----------	----------	----------
Foundries and steelworks	----------	----------	----------	(1)	(1)	(1)
Fillers:						
Paper	568,583	10,523,764	18.51	567,248	10,755,017	18.96
Paper coating	808,916	17,144,103	21.19	879,107	18,771,820	21.35
Rubber	100,342	1,377,951	13.73	105,094	1,335,956	12.71
Paint	66,160	1,342,605	20.29	50,304	985,895	19.60
Fertilizers	(1)	(1)	(1)	6,283	114,818	18.27
Plastics, organic	8,899	209,894	23.59	(1)	(1)	(1)
Exports	53,749	1,186,708	22.08	72,396	1,621,760	22.40
Other [2]	198,301	2,815,095	14.20	183,422	2,950,916	16.09
Total	2,121,237	37,822,255	17.83	2,147,178	39,557,122	18.42

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes stoneware (including chemical stoneware); glass refractories; saggers, pins, stilts, and wads, other refractories; linoleum and oilcloth, insecticides and fungicides, other fillers; portland and other hydraulic cements; catalysts; chemicals; other uses and uses indicated by footnote 1.

TABLE 5.—Miscellaneous clay sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Bibbs	(1)	(1)	(1)	(1)
Columbia	(1)	(1)	(1)	(1)
Crawford	300	$126	300	$125
Floyd	(1)	(1)	(1)	(1)
Fulton	(1)	(1)	(1)	(1)
Gordon	25,170	10,571	24,180	10,400
Houston	(1)	(1)	(1)	(1)
Polk	(1)	(1)	(1)	(1)
Richmond	(1)	(1)	(1)	(1)
Walker	(1)	(1)	80,000	31,500
Whitfield	(1)	(1)	(1)	(1)
Undistributed	1,278,574	549,830	1,216,201	539,117
Total	1,304,044	560,527	1,320,681	581,142

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Georgia led the Nation in production of kaolin and ranked second in fuller's earth. Eighteen companies mined kaolin from 23 pits in 8 counties (Baldwin, Floyd, Macon, Richmond, Sumter, Twiggs, Washington, and Wilkinson); 5 companies produced fuller's earth in Decatur, Grady, Jefferson, Thomas, and Twiggs Counties; and 15 companies mined miscellaneous clay in 11 counties. Leading producers were: Kaolin—American Industrial Clay Co., Georgia Kaolin Co., J. M. Huber Corp., Minerals & Chemicals Philipp Corp., Southern Clays, Inc., and Thiele Kaolin Co.; fuller's earth—Cairo Production Co., Diversey Corp., Georgia-Tennessee Mining & Chemical Co., Milwhite Co., and Waverly Petroleum Products Co.; and miscellaneous clay—Burns Brick Co., Chattahoochee Brick Co., Cherokee Brick Co., Merry Bros. Brick & Tile Co., and Oconee Clay Products Co. Mining operations at a Georgia kaolin pit were described.[7]

Feldspar.—Flotation Corporation, formerly Appalachian Minerals Co., mined feldspathic rock in Jasper County and produced a feldspar flotation concentrate for glass and pottery uses at its mill near Monticello.

Gem Stones.—A few pounds of rose quartz was reported during the year.

Gypsum.—Bestwall Gypsum Co. (Brunswick plant) and National Gypsum Co. (Savannah plant) calcined imported gypsum and manufactured wallboard and other gypsum products.

Mica.—Production of sheet mica totaled only 349 pounds of full-trimmed mica valued at $3,000, compared with 10,200 pounds at $88,600 in 1960. Only six operators were active during the year; all sales were to the Government through General Services Administration (GSA) at Spruce Pine, N.C. Sheet mica production came from Cherokee, Hart, Pickens, and Upson Counties. Scrap mica production was about the same as in 1960 and came from Cherokee and Hart Counties.

Sand and Gravel.—Total production of sand and gravel decreased 6 percent in tonnage; value remained approximately the same as in 1960. Sand decreased 7 percent in tonnage and 2 percent in value; gravel increased 17 percent in tonnage and 18 percent in value. The quantity and value of paving sand and gravel both increased. Building sand decreased in tonnage and value; building gravel tonnage was unchanged, but its value was 5 percent higher. Output of fill, filtration, glass and ground sand was lower than in 1960, while that of blast, molding, and other sands increased.

Twenty-four companies produced sand only from 28 pits in 21 counties, and 6 companies produced both sand and gravel from 6 pits in 4 counties. Crawford, Dougherty, Muscogee, Talbot, Taylor, and Thomas were the principal producing counties. Atlanta Sand and Supply Co. (Crawford County), Bannockburn Sand Co. (Brooks County), Calhoun Sand and Gravel Co. (Muscogee County), Dawes Silica Mining Co. (Dougherty, Effingham, Long, and Thomas Counties), Taylor Sand Co. (Talbot County), and Howard Sand Co. (Taylor County) were the principal producers.

Stone.—Stone ranked second in value of State mineral production. Total output of all stone increased 11 percent in tonnage and 3 percent in value. Crushed stone, comprising more than 98 percent of the total, increased 11 percent in tonnage and 4 percent in value, while dimension stone increased 18 percent in quantity but only 1 percent in value. Crushed granite, limestone, and sandstone were higher in both tonnage and value; crushed marble and sandstone decreased. Dimension granite although higher in quantity decreased in value, marble was up in both tonnage and value, and sandstone decreased in tonnage but was higher in value.

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[7] Brick and Clay Record. How Do You Mine Clay? V. 39, No. 4, October 1961, pp. 56–57, 77–78.

TABLE 6.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Bibb	(1)	(1)	(1)	(1)
Brooks	265,178	$217,618	214,376	$210,402
Camden	------------	------------	(1)	(1)
Chatham	(1)	(1)	(1)	(1)
Chattooga	1,482	3,334	1,410	3,172
Crawford	(1)	(1)	(1)	(1)
DeKalb	15,056	10,400	18,900	21,000
Dougherty	173,724	147,842	227,819	191,392
Douglas	7,000	5,000	------------	------------
Effingham	(1)	(1)	(1)	(1)
Elbert	2,600	1,500	8,926	6,070
Evans	9,525	9,525	8,305	12,457
Fulton	169,244	124,174	66,351	50,546
Glynn	(1)	(1)	(1)	(1)
Montgomery	(1)	(1)	22,680	22,680
Muscogee	(1)	(1)	(1)	(1)
Richmond	(1)	(1)	(1)	(1)
Sumter	------------	------------	25,000	17,000
Talbot	(1)	(1)	(1)	(1)
Tattnall	(1)	(1)	------------	------------
Taylor	363,500	182,100	326,975	172,185
Telfair	7,488	8,236	10,250	6,970
Thomas	(1)	(1)	(1)	(1)
Tift	2,500	2,500	------------	------------
Ware	31,270	48,091	20,792	28,000
White	4,000	3,000	------------	------------
Undistributed	2,285,252	2,283,842	2,198,062	2,306,826
Total	3,337,819	3,047,162	3,149,846	3,048,700

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

TABLE 7.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Structural sand	2,405,893	$1,627,290	$0.68	2,085,549	$1,514,082	$0.73
Paving sand	395,768	281,629	.71	485,458	367,731	.76
Molding sand	(1)	(1)	(1)	83,631	131,529	1.57
Filtration sand	(1)	(1)	(1)	13,865	31,615	2.28
Railroad ballast sand	8,787	6,814	.78	119	71	.60
Grinding and polishing sand	------------	------------	------------	114	70	.61
Other sand and gravel	[2] 527,371	[2] 1,131,429	[2] 2.15	[3] 481,110	[3] 1,003,602	[3] 2.09
Total	3,337,819	3,047,162	.91	3,149,846	3,048,700	.97

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other sand and gravel."

[2] Includes fill, glass, blast, engine, and other sands; structural and paving gravel; and uses indicated by footnote 1.

[3] Includes fill, glass, blast and other sands; structural, paving, and other gravel.

Stone was produced in 34 counties by 53 Company and Government-and-contractor operations. Dimension granite was produced in 6 counties and 29 quarries; crushed granite, in 16 counties from 22 quarries; and crushed limestone, in 8 counties from 10 quarries. Crushed and dimension marble was produced in Pickens County; crushed marble only, in Gilmer County. Crushed slate was mined in Bartow, Murray, and Polk Counties; quartzite, in Richmond County;

dimension sandstone, in Pickens County; crushed sandstone, in Polk County; and byproduct quartz, in Jasper County. Leading producers of crushed granite were Stockbridge Stone, Division of Vulcan Materials Co.; Tyrone Rock Division of Dixie Lime and Stone Co.; and Weston and Brooker Co. Leading producers of dimension granite were Coggins Granite Industries, Inc., Comolli Granite Co., and Davidson Granite Co., Inc. Georgia Marble Co. produced crushed and dimension marble; Marble Products Co. produced crushed marble only. Dalton Rock Products Co., Penn-Dixie Cement Corp., and Marquette Cement Manufacturing Co. were leading crushed limestone producers. Superior Stone Co., Division of Martin Marietta Corp., was the only producer of quartzite. Funkhouser Mills Division of Rubberoid Co. and Georgia Talc Co. mined slate for roofing granules; Georgia Lightweight Aggregate Co. mined slate for the use in the manufacture of lightweight aggregates.

TABLE 8.—Dimension granite sold or used by producers, by counties

County	1960			1961		
	Cubic feet	Short tons (equivalent)	Value	Cubic feet	Short tons (equivalent)	Value
DeKalb	810,196	67,230	$1,055,389	916,035	76,138	$1,179,449
Elbert	470,191	39,255	2,177,929	578,347	48,010	1,736,085
Hancock	19,175	1,592	28,763	26,270	2,180	39,406
Madison	169,382	14,059	508,146	174,795	14,508	436,987
Oglethorpe	(1)	(1)	(1)	(1)	(1)	(1)
Rockdale	(1)	(1)	(1)	(1)	(1)	(1)
Total	1,793,469	149,070	4,599,036	2,039,443	169,387	4,292,474

(1) Figure withheld to avoid disclosing individual company confidential data; included with "Total."

TABLE 9.—Dimension granite sold or used by producers, by uses

Use	1960			1961		
	Cubic feet	Value		Cubic feet	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
Rough monumental	769,644	$1,877,819	$2.44	897,027	$1,883,995	$2.10
Rubble	416,699	78,680	.19	(1)	(1)	(1)
Curbing and flagging	(1)	(1)	(1)	416,043	741,431	1.78
Dressed monumental	143,920	1,487,417	10.34	134,937	1,012,194	7.50
Rough construction	-----	-----	-----	(1)	(1)	(1)
Other [2]	463,206	1,155,120	2.49	591,436	654,854	1.11
Total	1,793,469	4,599,036	2.56	2,039,443	4,292,474	2.10

(1) Figure withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes dressed architectural stone and uses indicated by footnotel.

TABLE 10.—Crushed granite sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete, road metal	9,392,448	$13,905,600	$1.48	9,924,965	$14,412,349	$1.45
Riprap	(1)	(1)	(1)	535,009	784,410	1.47
Railroad ballast	117,196	162,020	1.38	500,743	684,461	1.37
Other	958,202	1,770,712	1.85	885,802	1,388,303	1.57
Total	10,467,846	15,838,332	1.51	11,846,519	17,269,523	1.46

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

TABLE 11.—Crushed limestone sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and road metal	784,357	$1,227,942	$1.57	971,842	$1,518,350	$1.56
Railroad ballast	(1)	(1)	(1)	3,234	4,689	1.45
Other [2]	913,360	1,530,144	1.68	825,244	1,335,849	1.62
Total	1,697,717	2,758,086	1.62	1,800,320	2,858,888	1.59

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Includes riprap, agstone, cement, and uses indicated by footnote 1.

The Barin granite quarry of Stockbridge Stone Division of Vulcan Materials Co., opened in 1960; its modern crushing plant was described in trade publications.[8]

Talc and Soapstone.—Georgia Talc Co., with mines and mill at Chatsworth, Murray County, mined crude talc and sold ground and sawed material. Crude production was up 19 percent in tonnage and 11 percent in value. Value of ground and sawed talc increased 21 percent.

Vermiculite.—Exfoliating plants were operated by Southern States Products Co. at Savannah and Zonolite Co. at Atlanta.

METALS

Bauxite.—American Cyanamid Co., the only producer, mined crude bauxite in Bartow, Floyd, and Sumter Counties. Crude production increased 3 percent in tonnage and 9 percent in value. Shipments were made to the company Halls Station drying plant and directly to other consumers.

Iron Ore.—Shipments of brown iron ore (including iron oxide pigments in 1961) were 27 percent higher in tonnage and 36 percent higher in value, average value per ton increasing from $4.79 to $5.15.

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[8] Pit and Quarry. V. 53, No. 10, April, 1961, pp. 106–113.
Rock Products. V. 64, No. 2, February, 1961, pp. 87–91.

Seventy-three percent of the ore was mined in the Stewart-Webster and Dooly-Pulaski areas south of the Fall Line; the remainder came from the Bartow-Polk County area in the northwestern part of the State. Leading producers were Brown-Nuggett Mining Co., Davis Bros., and Stewart Mining Co.

Crude iron oxide pigments increased 8 percent in tonnage and 13 percent in value, while finished pigments increased 4 percent in both tonnage and value. New Riverside Ochre Co. in Bartow County was the only producer.

Manganese.—Manganiferous ore (less than 35 percent Mn) decreased 30 percent in both tonnage and value. Two producers, Lake Mining Co. and Mosteller Bros., were active in Bartow County.

MINERAL FUELS

Coal (Bituminous).—Two operators, excluding those producing less than 1,000 tons, mined bituminous coal in Walker County. Production and value were approximately the same as in 1960.

Peat.—Production of peat dropped from the 1960 record high of 6,904 tons to 1,032 tons, lowest since 1944.

REVIEW BY COUNTIES

Mineral production was reported from 71 of 159 counties, compared with 76 in 1960. Nineteen counties had production valued above $1 million (10 of these exceeded $2 million), 74 percent of the State production. Leading counties in descending order were Twiggs, Washington, Pickens, Houston, Polk, De Kalb, Wilkinson, Bartow, Muscogee, and Richmond.

Baldwin.—General Refractories Co. mined kaolin at the Wood mine for use in refractories.

Bartow.—Value of mineral production decreased 4 percent; small increases in barite and crude iron oxide pigments and renewed bauxite production were not enough to offset losses in manganese, limestone, and slate. Usable brown iron ore production value was almost unchanged from the 1960 figure. Barite producers were B. R. Cain, Haney & McMicken Mining Co., Paga Mining Co., and New Riverside Ochre Co. The last company was the State's only producer of crude and finished iron oxide pigments. Thompson-Weinman and Co. operated a grinding plant at Cartersville to produce fillers and extenders from barite, kaolin, marble, mica, and other minerals. Funkhouser Mills Division of Ruberoid Co. mined slate to produce flour and roofing granules. Marquette Cement Manufacturing Co. quarried limestone for use in its cement plant at Rockmart. Hodge Mining Co. and Joe Mosteller mined brown iron ore; Lake Mining Co. and Mosteller Bros. mined both iron ore and manganiferous ores. American Cyanamid Co. mined a small quantity of bauxite and operated the Halls Station drying plant for treatment of its Georgia ore.

TABLE 12.—Value of mineral production in Georgia, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Baldwin	(2)	(2)	Kaolin.
Bartow	$3,299,896	$3,178,800	Barite, slate, limestone, iron ore, iron oxide pigments, manganiferous ore, bauxite.
Bibb	322,844	324,272	Sand and gravel, miscellaneous clay.
Brooks	217,618	210,402	Sand and gravel.
Camden	-----------	(2)	Do.
Chatham	(2)	(2)	Do.
Chattooga	3,334	3,172	Do.
Cherokee	(2)	(2)	Mica.
Clarke	(2)	(2)	Granite.
Clayton	(2)	(2)	Do.
Cobb	552,747	(2)	Do.
Columbia	(2)	(2)	Miscellaneous clay.
Crawford	(2)	(2)	Sand and gravel, miscellaneous clay.
Dade	(2)	(2)	Limestone.
Decatur	(2)	(2)	Fuller's earth.
DeKalb	(2)	(2)	Granite, sand and gravel.
Dooly	(2)	(2)	Iron ore.
Dougherty	147,842	191,392	Sand and gravel.
Douglas	(2)	(2)	Granite.
Effingham	(2)	(2)	Sand and gravel.
Elbert	2,179,429	1,742,155	Granite, sand and gravel.
Evans	9,525	12,457	Sand and gravel.
Fannin	(2)	192,304	Limestone.
Fayette	(2)	(2)	Granite.
Floyd	613,553	545,146	Limestone, bauxite, miscellaneous clay, kaolin.
Fulton	(2)	(2)	Granite, miscellaneous clay, sand and gravel.
Gilmer	(2)	1,296,508	Marble.
Glynn	(2)	(2)	Sand and gravel.
Gordon	10,571	10,400	Miscellaneous clay.
Grady	(2)	(2)	Fuller's earth.
Gwinnett	(2)	(2)	Granite.
Hall	(2)	(2)	Do.
Hancock	(2)	(2)	Do.
Hart	(2)	(2)	Mica.
Henry	(2)	(2)	Granite.
Houston	(2)	(2)	Cement, limestone, miscellaneous clay.
Jasper	(2)	708,064	Feldspar, sandstone.
Jefferson	300,242	362,327	Fuller's earth.
Jones	(2)	(2)	Granite.
Lamar	(2)	(2)	Do.
Long	(2)	(2)	Sand and gravel.
Lowndes	(2)	(2)	Peat.
Macon	(2)	(2)	Kaolin.
Madison	508,146	436,987	Granite.
Meriwether	(2)	-----------	
Mitchell	(2)	(2)	Limestone.
Montgomery	(2)	22,680	Sand and gravel.
Murray	118,300	124,100	Talc, soapstone, slate.
Muscogee	1,474,500	2,596,740	Granite, sand and gravel.
Oglethorpe	651,798	693,211	Granite.
Pickens	(2)	(2)	Marble, sandstone, mica.
Polk	(2)	(2)	Cement, slate, miscellaneous clay, sandstone, iron ore.
Pulaski	(2)	(2)	Iron ore.
Rabun	(2)	(2)	Granite.
Richmond	(2)	(2)	Sandstone, kaolin, miscellaneous clay, sand and gravel.
Rockdale	(2)	(2)	Granite.
Screven	(2)	-----------	
Stewart	(2)	(2)	Iron ore.
Sumter	(2)	(2)	Bauxite, kaolin, sand and gravel.
Talbot	(2)	(2)	Sand and gravel.
Tattnall	(2)	-----------	
Taylor	182,100	172,185	Sand and gravel.
Telfair	8,236	6,970	Do.
Thomas	(2)	(2)	Sand and gravel, fuller's earth.
Tift	2,500	-----------	
Towns	1	-----------	
Troup	150	10	Gem stones.
Twiggs	21,087,151	22,335,073	Kaolin, fuller's earth.
Upson	(2)	(2)	Mica.
Walker	(2)	193,630	Limestone, miscellaneous clay, coal.
Ware	48,091	28,000	Sand and gravel.
Warren	(2)	(2)	Granite.
Washington	10,808,208	13,109,268	Kaolin.

See footnotes at end of table.

TABLE 12.—Value of mineral production in Georgia, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Webster	(2)	$249,300	Iron ore.
White	$3,000	------------	
Whitfield	(2)	(2)	Limestone, miscellaneous clay.
Wilkinson	5,382,449	(2)	Kaolin.
Undistributed	43,270,770	46,510,447	
Total	91,203,000	95,256,000	

[1] The following counties are not listed because no production was reported: Appling, Atkinson, Bacon, Baker, Banks, Barrow, Ben Hill, Berrien, Bleckley, Brantley, Bryan, Bullock, Burke, Butts, Calhoun, Candler, Carroll, Catoosa, Charleton, Chattahoochee, Clay, Clinch, Coffee, Colquitt, Cook, Coweta, Crisp, Dawson, Dodge, Early, Echols, Emanuel, Forsyth, Franklin, Glascock, Greene, Habersham, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lanier, Laurens, Lee, Liberty, Lincoln, Lumpkin, McDuffie, McIntosh, Marion, Miller, Monroe, Morgan, Newton, Oconee, Paulding, Peach, Pierce, Pike, Putnam, Quitman, Randolph, Schley, Seminole, Spalding, Stephens, Taliaferro, Terrell, Toombs, Treutlen, Turner, Union, Walton, Wayne, Wheeler, Wilcox, Wilkes, and Worth.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Bibb.—Burns Brick Co. and Cherokee Brick Co. mined miscellaneous clay for manufacturing brick and other clay products. Cornell-Young Co. produced sand and gravel; Macon Brick and Block Co. and Sand Supplier, Inc., mined sand only for building and paving.

Brooks.—Bannockburn Sand Co. mined building, paving, and fill sand near Valdosta.

Camden.—Gray Towing Co. produced building and filtration sand at Brunswick.

Chatham.—Fitzgerald-Montgomery Sand Corp. produced building, paving, and fill sand at Savannah. National Gypsum Co. calcined imported crude gypsum for board, lath, and plaster at Savannah. Southern States Products Co. produced exfoliated vermiculite from crude ore shipped into the State.

Chattooga.—Wolf Creek Sand Co. produced unwashed molding sand.

Cherokee.—Glenn-Rey Corp. (Waleska mine) and Thompson-Weinman Co. (Brady mine) mined scrap mica (sericite); Alex Teague and Glenn Young produced a small quantity of full-trimmed sheet mica.

Clarke.—Gainesville Stone Co. quarried and crushed granite for concrete and roadstone.

Clayton.—Tyrone Rock Division of Dixie Lime and Stone (formerly Tyrone Rock Products Co.) quarried and crushed granite for concrete, roadstone and riprap.

Cobb.—Stockbridge Stone Division of Vulcan Materials Co. produced crushed granite for concrete and roadstone at the Kennesaw quarry.

Columbia.—Georgia Vitrified Brick and Clay Co. mined miscellaneous clay at the Campania mine for brick, pipe, and other clay products.

Crawford.—Atlanta Sand and Supply Co. (Rollo mine) produced building, paving, grinding, polishing, railroad ballast, and other sands. Middle Georgia Pottery Co. mined miscellaneous clay at Lizella to manufacture art pottery.

Dade.—Dave L. Brown Co. quarried limestone at Morganville for concrete and roadstone.

Decatur.—The Milwhite Co. mined and processed fuller's earth at Attapulgus.

De Kalb.—Tonnage and value of both crushed and dimension granite were higher than in 1960. Consolidated Quarries Division of Georgia Marble Co. and Stone Mountain Grit Co., Inc., produced crushed granite for concrete and roadstone, riprap, railroad ballast, stone sand, and poultry grit. Davidson Granite Co., Inc., quarried granite for dressed architectural, rough construction, rubble, and riprap. J. T. Reagin Granite Co. and Stone Mountain Granite Co. produced curbing, flagging, and rubble. Stamps Sand Co. mined paving sand.

Dooly.—Chandler Bros. mined brown iron ore near Unadilla.

Dougherty.—Albany Lime and Cement Co. produced filter sand. Dawes Silica Mining Co., Musgrove Sand Co., and Quick Service Sand Co. mined sand for building and paving.

Douglas.—Consolidated Quarries Division of Georgia Marble Co. quarried and crushed granite for concrete, roadstone, railroad ballast, stone sand, and riprap.

Effingham.—Dawes Silica Mining Co., Inc., produced building, blast, filtration, fertilizer filler, and molding sands.

Elbert.—Twelve companies operated 14 quarries in Elbert County and produced rough and dressed monumental stone totaling 578,000 cubic feet (48,000 tons) valued at $1.7 million, compared with 470,000 cubic feet (39,300 tons) valued at $2.2 million in 1960. Coggins Granite Industries, Inc., Comolli Granite Co., and Continental Granite Co., Inc., in terms of tonnage, were the largest producers. Venable crushing plant produced crushed granite for roadstone; Bond Sand and Gravel Co. mined building sand.

Evans.—Evans Concrete Products Co. mined building and paving sands.

Fannin.—Willingham-Little Stone Co., division of Georgia Marble Co., quarried and crushed limestone at Mineral Bluff for concrete, roadstone, and agstone.

Fayette.—Tyrone Rock Division of Dixie Lime and Stone Co. produced crushed granite at Tyrone for concrete roadstone, stone sand, railroad ballast, and riprap.

Floyd.—Ready-Mixed Concrete Co. and the Floyd County Highway Department quarried and crushed limestone principally for concrete and roadstone. Oconee Clay Products Co. mined shale for use in its clay products plant at Milledgeville. American Cyanamid Co. mined kaolin and bauxite from the New Holland mine.

Fulton.—Hitchcock Corp., Stockbridge Stone Division of Vulcan Materials Co., and Porter-Brown Limestone Co. crushed granite for concrete and road material. Atlanta Brick and Tile Co. and Chattahooche Brick Co. mined miscellaneous clay for use in manufacturing brick. W. J. Griffins, C. J. Ross, and Thompson Bros. Sand Co. mined building and paving sand for local use. Zonolite Co. (Atlanta plant) produced exfoliated vermiculite from crude ore shipped into the State.

Gilmer.—Willingham-Little Stone Co., division of Georgia Marble Co., mined and crushed marble for terrazo and other uses at Whitestone.

Glynn.—Gray Towing Co. produced building and filter sands. Bestwall Gypsum Co. calcined imported crude gypsum for wallboard and other building products.

Gordon.—Plainville Brick Co. mined shale for use in manufacturing brick at Plainville.

Grady.—Cairo Production Co. mined and processed fuller's earth for absorbent uses.

Gwinnett.—Stockbridge Stone Division of Vulcan Materials Co. and the State Board of Corrections quarried and crushed granite for concrete and roadstone.

Hall.—Gainesville Stone Co. quarried and crushed granite for concrete and roadstone.

Hancock.—Middle Georgia Quarrying Co. quarried rough granite monumental stone at Sparta. Weston & Brooker Co. produced crushed granite for concrete, roadstone, and stone sand.

Hart.—Funkhouser Mills Division of The Ruberoid Co. mined mica schist and produced ground mica at Hartwell for joint cement, roofing, and wallboard. Ralph Cunningham and Pat Buchanan produced a small quantity of sheet mica.

Henry.—Stockbridge Stone Division of Vulcan Materials Co. quarried granite for concrete, roadstone, and railroad ballast.

Houston.—Penn-Dixie Cement Corp. mined clay and limestone and manufactured portland cement at Clinchfield. Georgia Limerock Division of Dixie Lime and Stone Co. produced crushed limestone principally for agricultural use.

Jasper.—The Flotation Corporation (formerly Appalachian Minerals Co.) mined feldspar rock and produced flotation-grade feldspar and byproduct quartz at its Monticello mill.

Jefferson.—Georgia-Tennessee Mining & Chemical Co. mined and processed fuller's earth near Wrens for absorbent uses.

Jones.—Hitchcock Corp. (Gray quarry) and Weston & Brooker Co. (Ruby quarry) produced crushed granite for concrete, roadstone, and stone sand.

Lamar.—Tyrone Rock Division of Dixie Lime and Stone Co. quarried granite at Yatesville for concrete, roadstone, and railroad ballast.

Long.—Dawes Silica Mining Co. mined building sand at Ludowici.

Macon.—American Cyanamid Co. mined kaolin at the Cavender bauxite mine.

Madison.—Coggins Granite Industries, Inc., quarried granite for rough monumental stone.

Mitchell.—Bridgeboro Lime & Stone Co. quarried limestone for concrete, roadstone, and agstone.

Montgomery.—R. W. Geiger mined paving sand at Mt. Vernon.

Murray.—Georgia Talc Co. mined crude talc and marketed crayons and ground talc. The ground talc was used for asphalt filler, insecticides, roofing, rubber, and textiles. Georgia Talc also quarried and crushed slate for roofing granules.

Muscogee.—Brown Sand and Gravel Co. and Calhoun Sand and Gravel Co. mined both sand and gravel for building and paving. Stockbridge Stone Division of Vulcan Materials Co. quarried and crushed granite for concrete, roadstone, railroad ballast, and riprap at the Barin quarry north of Columbus.

Oglethorpe.—Nine companies quarried dimension granite principally for rough monumental stone. Leading producers were American Granite Quarries, Inc., Dixie Granite Co., Oglethorpe Granite Co., and Hoover Granite Quarries, Inc.

Pickens.—Pickens County continued as the third-ranking county in value of mineral production. Georgia Marble Co. quarried and dressed marble for building and monumental stone at Nelson and Tate. Calcium Products Division (New York mine) and Willingham-Little Stone Division (Goble mine), both of Georgia Marble Co., and Marble Products Co. of Georgia (Whitestone mine) mined and crushed marble for whiting, terrazo, and other uses. Carl Johnson and Hardy Johnson quarried dimension sandstone for flagging and rubble. Alex Teague produced sheet mica.

Polk.—Polk County ranked fifth in value of mineral production with little change in total value over 1960. Marquette Cement Manufacturing Co. produced portland and masonry cements at Rockmart from clay and sandstone mined in Polk County and limestone quarried in Bartow County by the cement company. Georgia Lightweight Aggregate Co. mined and expanded slate for lightweight aggregate at Rockmart. Two operators mined a small tonnage of brown iron ore.

Pulaski.—Pope and Chandler mined brown iron ore near Hawkinsville.

Rabun.—Rabun Quarries, Inc., quarried and crushed granite near Dillard for concrete and roadstone.

Richmond.—Albion Kaolin Division of Interchemical Corp. mined kaolin principally for fire brick and block and pottery and stoneware. Georgia-Carolina Brick & Tile Co., Georgia Vitrified Brick and Clay Co., and Merry Bros. Brick and Tile Co. mined miscellaneous clay for brick and other clay products. Superior Stone Co. Division of Martin Marietta Corp. quarried and crushed quartzite for concrete and roadstone. Augusta Sand and Gravel Co. produced paving sand; Speer Sand and Gravel Co., building and paving sand and gravel.

Rockdale.—Kelly Granite Co., Inc., quarried dimension granite for curbing, flagging, and rubble.

Stewart.—Although tonnage of brown iron ore was 3 percent lower than in 1960, value increased 2 percent. Only 3 producers were active: H. E. Bowden, Brown-Nuggett Mining Co., and Stewart Mining Co.

Sumter.—American Cyanamid Co. mined kaolin from the Holloway and Thigpen bauxite mines for use in refractories and cement manufacture. Americus Sand & Gravel Co. mined building sand.

Talbot.—Brown Bros. and Taylor Sand Co. mined building, paving, and molding sands near Junction City.

Taylor.—Butler Sand Co. and Howard Sand Co. mined building and paving sand.

Telfair.—Flanders Bros. mined building sand near Scotland.

Thomas.—Dawes Silica Mining Co. mined building, glass, filter, and other industrial sands. Waverly Petroleum Products Co. mined and processed fuller's earth for absorbent uses.

Troup.—A small quantity of gem material, rose quartz, was the only mineral production reported.

Twiggs.—Twiggs County ranked first in value of mineral production, Georgia Coating Clay Co., Georgia Kaolin Co., J. M. Huber Corp., and Southern Clays, Inc., mined and processed kaolin for all its various uses. Stephens Fire Brick Co. mined refractory kaolin for use in manufacturing fire brick and block. Diversey Corp. mined and processed fuller's earth, principally for insecticides and absorbent uses.

Upson.—J. E. Wilson and E. D. Buchanan mined a small quantity of sheet mica.

Walker.—W. T. Blevins Coal Co. and Powell and Hixon Coal Co. were the State's only bituminous coal producers. Key-James Brick Co. mined shale for manufacturing brick at the Chattanooga, Tenn. plant. Georgia Limestone Co. quarried limestone at Chicamauga for concrete, roadstone, and agstone.

Ware.—E. W. Pafford produced building sand near Waycross.

Warren.—Weston and Brooker Co. quarried and crushed granite at Camak for concrete, roadstone, stone sand and other uses.

Washington.—Washington County ranked second in value of mineral production. Kaolin (only mineral produced) was used for whiteware, pottery, refractories, heavy clay products, and paper coating and filling plus many other filler purposes. Producers were American Industrial Clay Co., Anglo-American Clays Corp., Champion Paper and Fibre Co., Minerals & Chemicals Philipp Corp., Thiele Kaolin Co., and United Clay Mines Corp.

Webster.—Brown ore production increased 80 percent in tonnage and 74 percent in value. Producers were B & C Construction Co., Brown-Nuggett Mining Co., and Davis Bros.

Whitfield.—Dalton Rock Products produced crushed limestone for concrete, roadstone, and agstone. Dalton Brick and Tile Corp. mined miscellaneous clay for brick and other clay products.

Wilkinson.—Kaolin, the only mineral produced in the county, was mined and processed principally for paper filling and coating, rubber, and paint by Evans Clay Co., Minerals & Chemicals Phillip Corp., and M & M Clay Co. Refractory kaolin was mined by Harbison-Walker Refractories Co., D. C. Hardie Clay Co., and Oconee Clay Products Co.

The Mineral Industry of Hawaii

This chapter has been prepared under a cooperative agreement for collecting mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Hawaii Department of Land and Natural Resources.

By Roy Y. Ashizawa[1]

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THE FIRST full year of portland cement production and an increased demand for crushed stone boosted the total value of Hawaii's mineral output to $14.6 million in 1961, compared with $9.3 million in 1960. The new plants on Oahu produced cement worth $5.6 million, capturing a major share of the State's market, which previously had been supplied by cement shipped from the mainland. Stone production increased from 3.5 million tons in 1960 to 4.4 million tons in 1961; the rise in demand resulted entirely from a surge in highway construction projects. The output of volcanic cinder, trachyte, and exfoliated vermiculite declined, owing to lower requirements for cinder for maintaining plantation roads and to less demand for these materials as lightweight concrete aggregate. The use of crushed coral limestone fines as a substitute for natural sand, coupled with a lower requirement of sand for concrete and concrete products, resulted in a lower output of sand and gravel. The production of lime for agricultural uses was up, as was that of black coral, gathered as a gem material. A small quantity of salt was also produced in 1961.

Employment and Injuries.—Hawaii's mineral industry reported to the Bureau of Mines that 654 employees, excluding office workers, worked 1,160,000 man-hours in 1961 compared with 640 employees and 962,000 man-hours in 1960. The gains in employment and man-hours occurred mainly at cement plants and stone quarries. The mineral industry reported 2 fatalities and 41 nonfatal lost-time injuries during the year.

Legislation and Government Programs.—In 1961 a cooperative agreement was made between the Federal Bureau of Mines and the Department of Land and Natural Resources, State of Hawaii, for the collection of mineral production data. None of the new ordinances or resolutions adopted by the city and county of Honolulu affected Oahu's mineral mining or quarrying operations. According to the Hawaii Department of the Attorney General, the regular 1961 session of the

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TABLE 1.—Mineral production in Hawaii[1]

Mineral	1960		1961	
	Short tons (unless otherwise stated)	Value (thousands)	Short tons (unless otherwise stated)	Value (thousands)
Cement .... 376-pound barrels	113,000	$571	1,076,800	$5,574
Clays	(2)	(2)	----	----
Gem stones	(3)	(2)	(3)	18
Lime	(2)	(2)	14,306	354
Pumice (volcanic cinder)	361,000	676	323,978	626
Salt	----	----	37	4
Sand and gravel	490,000	1,324	415,727	758
Stone	3,535,000	6,443	4,429,484	7,656
Value of items that cannot be disclosed: Values indicated by footnote 2	----	353	----	----
Total Hawaii[4]	----	9,254	----	14,588

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Weight not recorded.

[4] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

State Legislature passed Act 125 to appropriate $9,387 for the bauxite reclamation project. The project was established in 1958 in the Wailua Game Refuge Area on Kauai by the Hawaii Agricultural Experiment Station, University of Hawaii, to investigate problems in reclaiming land in strip-mined bauxitic areas. It was reported that with proper fertilization and cultivation, the reclaimed land was superior to the original area.

Metallurgical investigations completed by the Bureau of Mines on bauxite samples obtained in 1959 from Kauai, Maui, and Hawaii were incorporated in a report titled "Beneficiation of Hawaiian Bauxites" and presented to the State government in April 1961. A similar report was being prepared as a Bureau of Mines Report of Investigations. In June, the Federal Geological Survey and the State completed the first 2 years of a 4-year cooperative investigation on the economic geology of Hawaii's bauxite deposits. The work during the remaining 2 years was to consist of laboratory studies at Beltsville, Md., and the preparation of maps and a final geological report at Washington, D.C.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—In their first full year of operation the new plants of Hawaiian Cement Corp., Barbers Point, and Permanente Cement Co., Waianae, produced 1,115,000 barrels of portland cement and shipped 1,077,000 barrels. The cement supplied Hawaii's construction industry, which previously depended on cement shipped some 2,400 miles from the mainland. The year's shipments from the two plants, by type of customer, were as follows: 15 percent to building-material dealers, 12 percent to concrete-product manufacturers, 67 percent to ready-mixed-concrete companies, and 6 percent to government agencies and miscellaneous customers.

Pressurized-tank transport trailers, for pneumatically blowing bulk cement through piping systems to the customers' storage bins, were introduced to Hawaii by Permanente Cement Co. Permanente also announced plans for constructing cement distribution facilities at Kahului, Maui, at Hilo, Hawaii, and near Lihue, Kauai. The plants were to be completed by mid-1962. Each plant was to have a storage capacity of 2,000 barrels of cement which could be sacked or dispensed in bulk.

Clays.—A new company, Alii Enterprises, Inc., was formed to manufacture vitrified-clay sewer pipe, brick, roofing and drain tile, and other clay products on Oahu. The company acquired clay deposits near Kaneohe and Waimanalo and all of the equipment from the discontinued clay brick and tile plants of GasprO, Ltd., and Waialae Tile, Ltd., and established a new plant on a 2½-acre site in the James Campbell Industrial Park at Barbers Point. The plant was to be in production early in 1962, utilizing a 40-foot-diameter, round, downdraft fliln fired with fuel piped from the nearby Standard Oil Company of California refinery.

Gem Stones.—Continued demand for free-form jewelry and figurines created from Hawaii's black coral caused the collection of over 3,000 pounds of the gem material during 1961, a substantial increase over 1960. Although most of the coral was gathered from the deep channel between Maui and Lanai, new discoveries of black coral trees were made between Maui and Molokini Islands and in the waters off Kahului, Maui; Manele, Lanai; and Waimea, Kauai. Self-contained underwater-breathing apparatus (SCUBA) was used by divers who worked at depths of 80 to over 200 feet (at the risk of serious injury due to the bends) to collect the precious black coral referred to as *ako akoa eleele*.

Lime.—Producers on Oahu and Maui sold or used 14,306 tons of hydrated lime. Gains were reported in the quantities of hydrated lime sold for agricultural and masonry uses; sales to sugar mills, the principal consumer, and to pineapple canneries declined slightly. Coral limestone was calcined at the Oahu plant. The Maui plant was the only lime operation in the United States using coral beach sand to produce lime. Each of the plants operated a rotary kiln and a continuous hydrator.

Pumice (Volcanic Cinder).—Output of volcanic cinder and trachyte dropped from 361,000 tons in 1960 to 324,000 tons in 1961. Production would have been considerably lower had it not been for the large volume of cinder and ash utilized for road base and orchard covering on Hawaii Island. There was generally less road construction and maintenance activity at sugarcane and pineapple plantations and in the rural areas of the State. The quantities of lightweight concrete aggregate produced from volcanic cinder and trachyte were also less than in the previous year.

Salt.—A small quantity of salt was produced on Oahu by solar evaporation. Smith Chemical Products, Inc., completed construction of its plant and pond facilities at Barbers Point and made test runs during the latter part of the year. Tamotsu Tanaka produced salt on a 7.7-acre site on the west fringe of Sand Island near Honolulu. The pond sites in the Pearl Harbor area continued to remain idle.

Sand and Gravel.—Output of natural coral beach and dune sands and of basaltic sand and gravel from stream and beach deposits was down to 416,000 tons, from 490,000 tons in 1960. The construction industry on Oahu was the principal consumer of coral sand, blending it with crushed basalt fines for use in portland cement concrete aggregate. The production of coral beach and dune sands from northern Oahu dropped considerably, owing to the year's lower volume of building activity and to the increased use of sand barged from Molokai and of stone sand manufactured by several producers of coral limestone. A sand preparation plant was operated as an integral part of Permanente's Waianae cement plant to screen, classify, and wash the fines from the crushed limestone used in making cement.

Basaltic streambed sand and gravel was utilized noncommercially by public works crews and contractors and at plantations and cattle ranches, primarily for road repairs. The first known commercial gravel operation in the State was established on Maui Island to process basaltic streambed gravel for use in ready-mixed concrete.

Stone.—Stone production increased from 3.5 million tons in 1960 to 4.4 million tons. The use pattern of the quarried stone changed during 1961. A greater volume of the crushed basalt, limestone, and miscellaneous stone was used for base coursing and surfacing of roads, and less for structural applications.

Commercial producers and government crews and contractors quarried 2.8 million tons of basalt rock on Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu Islands. Nearly 960,000 tons of quarried and dredged coral limestone was processed on Hawaii, Kauai, and Oahu for base course, concrete aggregate, and agricultural purposes, and for producing cement and lime. The cement plants on Oahu consumed 258,000 tons of quarried limestone in 1961. The output of miscellaneous basaltic stone, including Hawaiian aa, fieldstone, moss rock, and decomposed rock, increased from 400,000 tons in 1960 to 710,000 tons. Miscellaneous stone was used extensively on Hawaii Island for base coursing and surfacing of roads and also for retaining walls and decorative building facing.

Vermiculite.—Vermiculite was exfoliated at the Honolulu plant of Vermiculite of Hawaii, Inc., for use in lightweight building plaster and concrete aggregate, soil conditioning, loose-fill insulation, and decorative acoustic ceilings. The crude vermiculite was shipped from the Zonolite Co. mine near Libby, Mont.

MINERAL FUELS

The catalytic cracking plant and related facilities at the Standard Oil Co. of California refinery at Barbers Point was completed, and production of high-octane motor and aviation gasolines began at the end of 1961. Ceremonies marking the completion of all of the facilities at Hawaii's first full-scale oil refinery were scheduled for January 11, 1962, 75 years after Standard Oil made its first sale in the Hawaiian Islands of 10,000 cases of kerosine. Texaco, Inc., expanded its operations by establishing new terminals and service stations on Oahu, Maui, and Hawaii Islands. Texaco's main facility at Barbers Point received its supply of mainland petroleum products through its terminal and pipelines at the nearby barge harbor.

REVIEW BY ISLANDS

Hawaii.—Hawaii Island mineral producers supplied mineral materials for road construction and for rebuilding the city of Hilo, which was devastated by a 15-foot tidal wave in May 1960. The James W. Glover, Ltd., Hilo quarry supplied a substantial quantity of basalt rock for building and paving. Glover's portable crusher was shipped back to Hawaii Island from a highway project on Lanai Island and was set up near Keaau (Olaa) to process aa rock for a road project. Kuwaye Bros., Inc., quarried over 200,000 cubic yards of aa and other volcanic material from the 299th pit near Hilo and a pit at the Hawaii National Park. Virtually all of it was used for road construction, including base coursing of the new bypass road in the park. Yamada & Sons, Inc., worked various pits near Hilo, Honokaa, Naalehu, and Manuka Park, to produce aa and decomposed rock, primarily for construction of secondary roads at sugar plantations, new subdivisions, and other private and government projects. The company operated portable crushers at the 299th pit and at Kawaihae. Stockpiles of coral limestone dredged from Kawaihae Harbor were crushed and screened for agricultural purposes. J. M. Tanaka Contractors, Inc., quarried and processed basalt and aa rock, 6 miles southeast of Kailua-Kona. Corps Construction, Ltd., in the same area, purchased all of its requirements of crushed aggregate during 1961.

TABLE 2.—Value of mineral production in Hawaii, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Hawaii	$1,394,001	$2,054,724	Stone, pumice (volcanic cinder), sand and gravel.
Honolulu	6,526,046	11,764,081	Stone, cement, sand and gravel, lime, pumice (volcanic cinder), salt.
Kauai	563,673	208,032	Stone, sand and gravel, pumice (volcanic cinder), gem stones.
Maui	770,124	561,106	Stone, sand and gravel, lime, pumice (volcanic cinder), gem stones.
Total	9,254,000	14,588,000	

A substantial quantity of volcanic rock was processed in the Papa area for construction of the South Kona highway. The Pahoa area was the source of lava rock used in slabs for decorative interior and exterior building construction. Hilo Sugar Co., Ltd., required more than 80,000 cubic yards of volcanic cinder and aa rock, which were obtained from the 299th, Halai Hill, and Akolea quarries near Hilo, for construction and maintenance of company roads. The Waipunalei quarry near Papaaloa supplied volcanic material for heavy repairs and construction of new roads at the Laupahoehoe Sugar Co. plantation. Decomposed rock from a company pit was stripped with a bulldozer and shovel-loaded for use in building and maintaining Paauhau Sugar Co., Ltd.'s roads. Kohala Sugar Co. located a new quarry site within 2 miles of Hawi during 1961 and produced an appreciable amount of aggregate for road maintenance. Hawaiian Agricultural Co., Ltd., obtained road material from its aa and cinder pits in the Pahala area. State and county crews obtained aa, decomposed rock, and One-Man-Stone from various locations for road surface maintenance and repairs to road embankments. Road crews at the Hawaii National Park crushed 175 cubic yards of volcanic rock in the Kilauea Volcano area. Basaltic beach gravel and streambed sand and gravel were used by government crews and contractors, primarily for road repairs.

Lightweight trachyte was quarried and processed by Volcanite, Ltd., at the base of the north side of Puuwaawaa, a cone over 1,200 feet high. Volcanite used a fleet of end-dump semitrailers to haul the processed material to Kona for use in hollow-block and extruded hollow-core concrete beams, and to Kawaihae Harbor for shipment by barge to Oahu. Screened volcanic ash was produced by Kuwaye Bros., Inc., near Pahoa for use at the Keaau Orchards to prepare a smooth surface for mechanically harvesting macadamia nuts. The company also used volcanic cinder as base material for a road construction project. Hawaii Thermal Power Co., formed by Magma Power Co., Los Angeles, Calif., contracted for the drilling of exploratory wells on the Puna rift, in an attempt to locate an underground source of live steam. The first four wells were not productive, and drilling continued.

Kauai.—Grove Farm Co., Ltd., quarried basalt rock near Puhi and coral limestone from a deposit 3¼ miles southeast of Koloa, for building and paving use. Some of the limestone was screened for agricultural purposes. The company also produced volcanic cinder from the Koloa cinder pit, 2 miles southeast of Koloa, for patching its plantation roads. Decomposed basalt rock, containing secondary carbonate materials, was quarried near Kilauea for use in constructing plantation roads for Kilauea Sugar Co., Ltd., as well as for other paving projects including the driveway for the new hotel at Hanalei. On October 1 the quarry was acquired by Grove Farm Co., Ltd., on a 10-year lease.

Coral limestone dredged from the reef off Kapaa and stockpiled in 1959 was used by Lihue Plantation Co., Ltd., for constructing and maintaining company haul roads. McBryde Sugar Co., Ltd., worked the Kapeku cinder hill near Kalaheo to obtain black cinder and weathered cinder, primarily for company use in concrete aggregate and for road base and surfacing. Coral beach sand and basaltic streambed sand and gravel also were used on Kauai for concrete and for road maintenance. A small quantity of black coral gem material was collected in the deep waters off Waimea by a SCUBA diver from Maui Island.

Lanai.—James W. Glover, Ltd., continued to quarry and process basalt and aa rock near Kaumalapau during January to complete a highway project begun in 1960. The company's portable crusher was then shipped back to Hawaii Island. A SCUBA diver from Maui Island collected a small quantity of black coral gem material in the deep waters off Manele.

Maui.—Basalt rock was quarried and processed by Kahului Railroad Co. at Camp 10 near Puunene to supply crushed stone to local building and paving contractors and ballast for the company's rail lines. Maui Aggregates, Inc., established Hawaii's first known commercial gravel operation several miles southwest of Waikapu. The company set up a crusher near a stream and processed natural streambed gravels for use in ready-mixed concrete. Other stream deposits on Maui supplied road gravel, mainly for use by county maintenance crews. The Kaa beach area and the Wailuku dunes were sources of coral sand used in structural concrete, in maintaining plantation roads, and as railroad engine sand.

Hawaiian Commercial & Sugar Co., Ltd. (HC&S), operated the oil-fired limekiln near Lower Paia to produce hydrated lime. Coral beach sand was obtained from the adjacent beach and screened and fed to the plant for use in making the lime. Near Maalaea, HC&S utilized a power shovel to obtain volcanic cinder from the Puuhele cinder pit for use in concrete aggregate. County crews operated the Honokohau ash pit and the Kahakuloa cinder pit near Puu Kaeo in northwestern Maui to remove material used for year-round maintenance as well as for repairs to roads. Both the Wahikuli pit near Lahaina and the Honokohau pit were sources of cinder and ash used by Baldwin Packers, Ltd., for plantation roads. The output of cinder from deposits near Makawao, Ulupalakua, and Red Hill (at the summit of Haleakala Crater) was small during 1961.

Maui Divers of Hawaii, Ltd., Lahaina, continued to collect substantial quantities of black coral gem material from the deep channel between Maui and Lanai, for use in creating polished black coral jewelry. Other SCUBA divers worked newly discovered deposits of black coral trees in the waters off Kahului and Makena, and near La Perouse Bay.

Molokai.—Lightweight volcanic cinder and coral sand were produced by Honolulu Construction & Draying Co., Ltd., at Waieli and Papohaku Beach, respectively, and shipped by barge from Lono Harbor to Oahu for use in concrete aggregate. The company used a bulldozer and operated a primary crusher at the cinder deposit; a dragline scraper was used to obtain the beach sand. Local requirements of cinder for construction and repairs to rural roads were supplied mainly from the Puuluahine pit near Kaunakakai.

The basalt quarry at Manawainui Gulch, 3½ miles northwest of Kaunakakai, was acquired by Molokai Aggregates, Inc., from its former operator, Molokai Rock & Equipment. The year's output from the quarry was used for local building and paving projects as well as for concrete aggregate at the Molokai water tunnel project. The State Department of Health installed a rock crusher at the Kalaupapa Settlement in Kalawao County in northern Molokai. A small quantity of volcanic rock was processed for use in the settlement's own projects. The Moomomi dunes supplied virtually all of the coral sand used for concrete aggregate.

Oahu.—The Hawaiian Cement Corp. dry-process plant at Barbers Point and the Permanente Cement Co. wet-process plant at Waianae completed their first full year of operation and added $5.6 million to the value of Oahu's mineral output. Stone quarries on Oahu yielded 2.5 million tons of basalt rock and 899,000 tons of coral limestone. Clarke-Halawa Rock Co., Hawaii division of Pacific Cement and Aggregates, Inc. (PCA), was the principal stone producer on Oahu and in the State. PCA quarried basalt near Aiea and limestone near Lualualai, for riprap, concrete aggregate, roadstone, roofing granules, and lime manufacture. Honolulu Construction & Draying Co., Ltd., at the Kapaa quarry east of Kailua, and Hawaiian Rock & Supply Co., Ltd., at the Kaena quarry southeast of Camp Erdman, produced basalt rock. Pacific Concrete & Rock Co., Ltd., quarried basalt at the Palailai quarry north of Ewa and coral limestone at the south fringe of Kailua. Nanakuli Paving & Rock Co., Ltd., operated the Testa limestone quarry, east of the junction of Farrington Highway and Hakima Road near Nanakuli.

Morrison-Knudsen Co., Inc., established portable primary and secondary rock crushers near the multistructure Lunalilo Freeway project to prepare basalt rock, blasted and excavated from the main roadway, for use as paving material and structural concrete aggregate. The Concrete Products Division of Kaiser Hawaii-Kai Development Co. operated a crusher to process basaltic field boulders from Kamilonui Valley and volcanic cinder from Makiki Round Top for concrete aggregate used in constructing homes at the new Hawaii-Kai Marina subdivision at Kuapa Pond. I. Doi Trucking Co. also obtained cinder from Makiki Round Top for use as cushion material under concrete slabs and drain pipes.

Oahu Aggregates, Inc., created a barge harbor at Barbers Point while drilling, blasting, and excavating coral limestone to a depth of 29 feet. Washed stone sand and other coarser grades of aggregate were produced at the nearby company crusher and sand preparation plant. Inland Rock Co. used a bulldozer with a ripper to work the Hawaiian Cement Corp. limestone quarry at Barbers Point. Permanente Cement Co. obtained limestone from a quarry 2 miles west of its Waianae plant. A U.S. Army engineer battalion quarried and processed basalt rock at the Kolekole quarry for use in maintaining roads at nearby Schofield Barracks. Road construction crews at Ewa Plantation Co. quarried coral limestone from company pits. Kahuku Plantation Co. also produced limestone, from its Field 23 Malaekahana quarry near Kahuku and its Field 28 quarry near Laie for constructing and maintaining plantation roads. Moss rock was gathered from the Waianae area by Joe's Moss Rock Co. and sold to individuals and contractors for use as decorative stone.

The quantity of coral sand obtained by commercial producers from the beaches and dunes near Haleiwa and Mokuleia was less than the output in 1960. Although not counted in the statistics, a considerable amount of coral sand periodically was hauled from northern Oahu to the Waikiki tourist area to replenish the beach sand lost to wave action and to shifting ocean currents. Public works construction and maintenance crews obtained their own requirements of coral sand from the Makaha, Nanakuli, Mokapu, and other beach areas.

Salt for local consumption was produced at Barbers Point and at Sand Island by solar evaporation. GasprO, Ltd., operated the oil-fired limekiln at Waianae to produce hydrated lime for the sugar, pineapple, and construction industries. The plant's raw material was purchased from a nearby coral limestone quarry. A new oxygen column was added to GasprO's gas plant to increase the company's capacity to produce high-purity gas and liquid nitrogen and oxygen. Clay deposits near Kaneohe and Waimanalo were leased from the State by Alii Enterprises, Inc., Honolulu, to provide raw material for its new clay-products plant at Barbers Point. Vermiculite of Hawaii, Inc., Honolulu, continued to exfoliate crude vermiculite from Montana to produce special lightweight aggregate used in structural and decorative building materials and for soil conditioning.

The Mineral Industry of Idaho

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Bureau of Mines and Geology.

By Frank B. Fulkerson,[1] Gary A. Kingston,[2] and Norman S. Petersen[3]

❖

IDAHO'S mineral-production value was $68.9 million in 1961. This was $11.5 million more than the State mineral industry produced in 1960 when a lengthy metal-mining strike reduced the total value. Idaho's silver output was the largest in 23 years, and the combined lead and zinc tonnage was the largest in 7 years. Monthly production of metals tapered off after mid-1961 as the result of a drop in the lead price and a strike at the Lucky Friday mine. In all, 24 mineral commodities were produced. Silver miners benefited when the U.S. Treasury stopped selling silver to industrial users at 91⅝ cents an ounce. The market price rose to 104¾ cents at yearend. Silver, the principal product—supplying 24 percent of the State mineral-production value—and lead, zinc, phosphate rock, and sand and gravel contributed 86 percent of the total. Other important products were stone, copper, and cement. Among the nonmetals, cement, sand and gravel, and stone production increased. Reduced demand for phosphate rock interrupted the rapidly growing production rate for this commodity and lowered the total nonmetal value below 1960. Output of all phosphate mines was reduced compared with 1960, and two mines were idle.

The mineral production index was 103, compared with 87 in 1960 (1959=100). The index was an average of the percentage gains and losses in quantities produced, weighted by the 1961 commodity values.

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[2] Geographer, Bureau of Mines, Albany, Oreg.
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TABLE 1.—Mineral production in Idaho [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate short tons, antimony content	635	(2)	689	(2)
Clays [3] thousand short tons	36	$29	27	$20
Copper (recoverable content of ores, etc.) short tons	4,208	2,702	4,328	2,597
Gold (recoverable content of ores, etc) troy ounces	6,135	215	5,718	200
Iron ore (usable) thousand long tons	9	(2)	12	70
Lead (recoverable content of ores, etc.) short tons	42,907	10,040	71,476	14,724
Lime [4] thousand short tons	------------	------------	47	658
Mercury 76-pound flasks	1,538	324	1,073	212
Phosphate rock thousand long tons	2,177	11,044	1,440	7,984
Pumice thousand short tons	56	88	60	95
Sand and gravel do	7,088	6,594	7,305	6,793
Silver (recoverable content of ores, etc.) thousand troy ounces	13,647	12,351	17,576	16,249
Stone thousand short tons	1,318	2,141	1,873	3,111
Titanium concentrate short tons, gross weight	2,014	30	1,873	28
Zinc (recoverable content of ores, etc.) short tons	36,801	9,495	58,295	13,408
Value of items that cannot be disclosed: Barite, cement, garnet (abrasive), gem stones, recycled lime, mica (1960), peat, perlite (1961), tungsten (1961), uranium ore, vanadium (1961), and values indicated by footnote 2. Excludes value of raw materials used in manufacturing cement and lime	------------	2,388	------------	2,751
Total Idaho	------------	57,441	------------	68,900

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Excludes fire clay, kaolin, and bentonite; included with "Value of items that cannot be disclosed."

[4] Excludes recycled lime; included with "Value of items that cannot be disclosed."

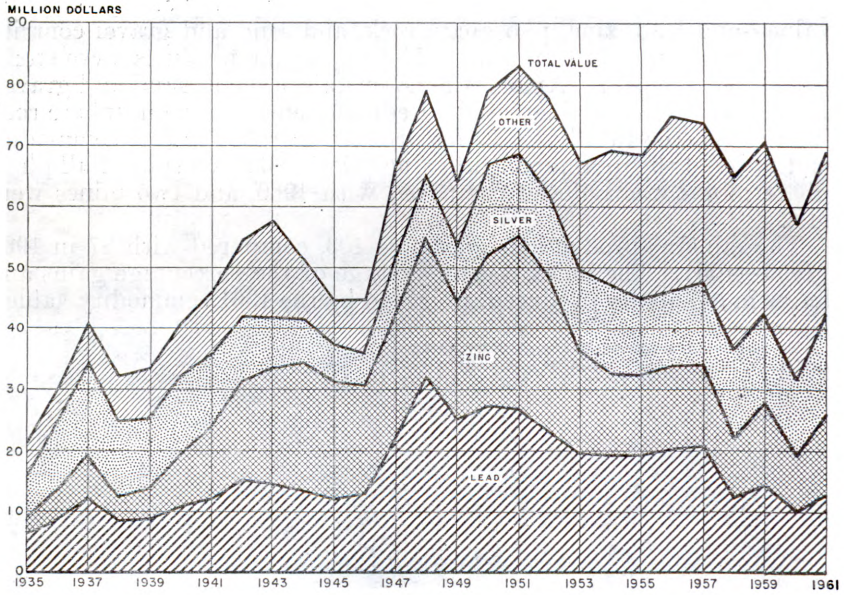

FIGURE 1.—Value of silver, lead, and zinc and total value of mineral production in Idaho, 1935–61.

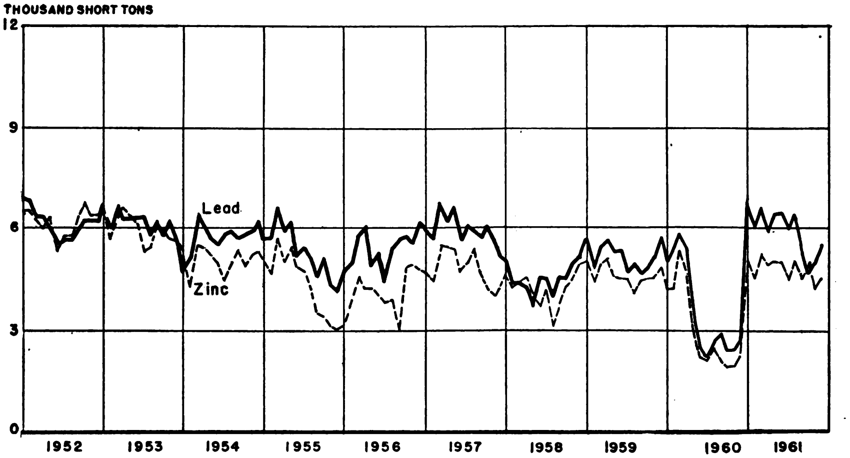

FIGURE 2.—Mine production of lead and zinc in Idaho, 1952–61, by months, in terms of recoverable metals.

TABLE 2.—Indications of Idaho business activity

	1960	1961[1]	Change, percent
Personal income:			
Total ... millions	$1,205.0	$1,268.0	+5.2
Per capita	$1,796.0	$1,854.0	+3.2
Construction activity:			
Building permits ... millions	$33.9	$36.5	+7.7
Heavy engineering awards ... do	$64.6	$86.7	+34.2
State highway commission:			
Value of contracts awarded ... do	$19.3	$34.0	+76.2
Value of contract work performed ... do	$17.7	$23.2	+32.4
Cement shipments to and within Idaho thousand 376-pound barrels	1,351.1	1,125.4	−16.7
Cash receipts from farm marketings ... millions	$432.2	$427.8	−1.0
Mineral production ... do	$57.4	$68.9	+19.7
Factory payrolls ... do	$148.0	$153.2	+3.5
Annual average labor force and employment:			
Total labor force ... thousands	262.7	266.6	+1.5
Unemployment ... do	14.1	16.5	+17.0
Employment:			
Construction ... do	9.6	10.0	+4.2
Food processing ... do	9.9	10.3	+4.0
Lumber ... do	11.8	10.9	−7.6
All manufacturing ... do	30.1	30.2	+0.3
All industries ... do	247.7	250.0	+0.9

[1] Preliminary figures.

Source: Survey of Current Business, Construction Review, Pacific Builder and Engineer, Idaho State Highway Commission, The Farm Income Situation, Idaho Labor Market, Labor Force and Employment in Idaho, Distribution by Industry of Wages Paid for Covered Employment in Idaho, and Bureau of Mines.

A number of developments took place in the phosphate industries. FMC Corp., Mineral Products Division, completed a $3 million construction program at its Pocatello elemental-phosphorous plant and announced plans for further expansion during the next 2 years. West of Pocatello, J. R. Simplot Co. continued to expand its fertilizer plant. The Bunker Hill Co. made initial shipments of phosphoric acid from a new fertilizer plant at Kellogg.

Consumption of construction materials benefited from increased construction, and improved economic conditions in the last half of 1961. Highway building and work at the Mountain Home missile-base site were important to the gain in State construction. Most of the annual statistics reflecting construction activity, including building permits, heavy engineering awards, and highway contract work performed, recorded large gains over 1960. Construction employment and average weekly hours of construction workers increased also. Per capita personal income in Idaho gained 3 percent (compared with 2 percent nationally) as the result of settlement of strikes in the mining and primary metals industries and expansion in several other nonagricultural industries, including construction, food processing, and the State and local government sector (including education). Unemployment, averaging 6.2 percent of the labor force, was high because of continued growth of the labor force and economic recession in metal mining and lumber industries as the result of poor markets.

Idaho Bureau of Mines and Geology published informative bulletins on the Idaho gold rush of the 1860's[4] and on the history and development of the State's mineral industries.[5]

Employment and Injuries.—Employment figures were provided by the Idaho Employment Security Agency. Metal mining provided 48 percent of mineral industry employment; phosphate fertilizers, elemental phosphorus, and sulfuric acid, 20 percent; primary metals processing, 16 percent; stone and clay products manufacturing, 11 percent; and nonmetal mining, 5 percent. The number of workers in metal mining and primary metals was greater than in 1960, when employment was reduced by long strikes.

Injury data in table 5 were compiled from reports by mining companies to the Bureau of Mines.

Government Programs.—The Office of Minerals Exploration (OME) and Idaho Copper Mines, Inc., signed a contract covering exploration for copper and cobalt in Lemhi County. The contract was for $88,030 with Government participation of 50 percent. The only other active contract in Idaho at the end of the year under the Government program to encourage exploration for strategic and critical minerals was with American Smelting and Refining Co. in Shoshone County.

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[4] Wells, Merle W. Rush to Idaho. Idaho Bureau of Mines and Geol., Bull. 19, 1961, 57 pp.

[5] Idaho Bureau of Mines and Geology. Idaho's Mineral Industry—the First Hundred Years. Bull. 18, 1961, 71 pp.

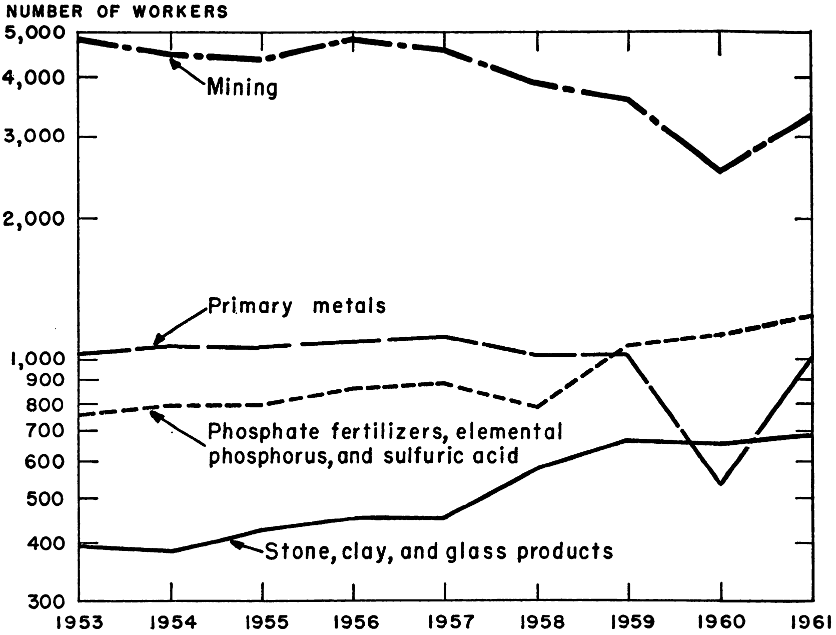

FIGURE 3.—Employment trends, 1953–61.
(Source: Idaho Employment Security Agency.)

TABLE 3.—Annual employment and wages paid in the mineral industries

Year	Mining							
	Metals		Nonmetals		Fuels		Total	
	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)
1957	4,388	$23,716	249	$1,123	21	$84	4,658	$24,923
1958	3,633	19,359	259	1,281	27	149	3,918	20,789
1959	3,305	18,393	292	1,379	20	127	3,619	19,899
1960	2,282	13,550	235	1,187	20	132	2,537	14,869
1961	3,032	17,607	288	1,785	2	5	3,322	19,397
	Manufacturing							
	Stone and clay products		Primary Metals		Phosphate fertilizers, elemental phosphorus, and sulfuric acid		Total	
1957	451	$1,980	1,232	$6,818	880	$4,932	2,563	$13,730
1958	579	2,760	1,034	5,314	787	4,518	2,400	12,592
1959	664	3,228	1,036	5,656	[1] 1,139	[1] 6,834	2,839	15,718
1960	654	3,376	534	3,023	1,244	7,091	2,432	14,390
1961	677	3,457	1,008	5,750	1,250	8,263	2,935	17,470

[1] Part of the 1959 gain was due to obtaining greater detail from multi-industry employees.

Source: Idaho Employment Security Agency; employment covered by unemployment insurance. Industry groups may not correspond with those in the Bureau of Mines canvass.

TABLE 4.—Hours and earnings of production workers in mining

	1957	1958	1959	1960	1961
Annual average:					
Weekly earnings	$101.02	$95.68	$101.91	$103.21	$105.32
Hourly earnings	$2.47	$2.53	$2.58	$2.66	$2.62
Weekly hours	40.9	37.7	39.5	38.8	40.2

Source: Idaho Employment Security Agency.

TABLE 5.—Injury experience in the mineral industries[1]

Year and industry	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:						
Quarries and mills[2]	182	133	194,056	---------	4	21
Nonmetal mines and mills[3]	608	242	1,178,492	---------	39	33
Sand and gravel operations[3]	280	178	399,447	---------	12	30
Metal mines and mills[3]	2,663	183	3,892,245	1	266	69
Coal mines	---------	---------	---------	---------	---------	---------
Total	3,733	190	5,664,240	1	321	57
1961:[4]						
Quarries and mills[2]	189	125	189,620	---------	1	5
Nonmetal mines and mills[3]	704	259	1,485,448	1	17	12
Sand and gravel operations[3]	239	142	269,332	---------	---------	---------
Metal mines and mills[3]	2,716	239	5,205,544	---------	526	102
Coal mines	---------	---------	---------	---------	---------	---------
Total	3,848	231	7,149,944	1	544	76

[1] Compiled by the Bureau of Mines from reports by individual companies.
[2] Includes cement- and lime-processing plants.
[3] Excludes officeworkers.
[4] Prelininary figures.

TABLE 6.—Office of Minerals Exploration contracts active during 1961

County and contractor	Property	Commodity	Contract		
			Date	Total amount	Government participation, percent
Valley:					
Copper Camp Co.[1]	Copper Camp, prospect.	Copper	June 17, 1960	$34,840	50
Lemhi:					
Idaho Copper Mines, Inc	East Fork, et al, claims.	Copper-cobalt.	Sept. 21, 1961	88,030	50
Shoshone:					
American Smelting and Refining Co.[2]	East Page mine.	Lead-zinc	Sept. 18, 1957	660,206	50

[1] Contract rescinded before work was started.
[2] DMEA contract.

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—Antimony output came principally from the Sunshine Mining Co., Sunshine mine, Shoshone County, known primarily as a major silver producer. A small quantity of silver-copper-antimony concentrate was purchased from Hecla Mining Co. Ore mined at the Silver Summit property and beneficiated at the Polaris mill was the source of the Hecla concentrate. The Sunshine and Silver Summit mines concentrate was processed electrolytically by the Sunshine company and marketed as cathode metal, averaging 95.4 percent contained antimony. Reported production is in terms of antimony contained in cathode metal.

Beryllium.—Exploration of previously located occurrences and the search for new deposits of beryllium ores were continued by companies and individuals and by State and Federal agencies under a cooperative project. A joint field exploration project of the Federal Bureau of Mines and the Idaho Bureau of Mines and Geology was completed. In addition to the mineralized areas discovered in 1960 by the Federal-State field-exploration teams, several more beryl occurrences were located in the Sawtooth Mountains and other areas, including beryl-bearing pegmatites near Pierce, Clearwater County.

Cobalt.—An OME contract was obtained by Idaho Copper Mines, Inc., for a cobalt-exploration project at a property in the Indian Creek mining district, Lemhi County.

Columbium-Tantalum.—Porter Bros. Corp. continued to maintain the Lowman and Bear Valley facilities in operational readiness. Reactivation of mining was pending development and construction of a proposed metallurgical unit to treat columbium-tantalum-bearing euxenite recoverable from the Bear Valley black sand deposit. Cooperative work was completed between the Porter company and the Federal Bureau of Mines to develop a metallurgical process.

Idaho's black sand deposits were the subject of a State publication.[6]

Copper.—Copper was produced from mines in Shoshone, Custer, Adams, and Lemhi Counties, in descending order of output. By far the greater quantity was recovered as a byproduct from the Galena, Sunshine, and other Shoshone County mines.

Gold.—The Lucky Friday mine, Shoshone County, was the largest single gold producer and accounted for 24 percent of the State total. Gold output of the Lucky Friday mine was a byproduct of silver and lead. Other Coeur d'Alene area mines also yielded byproduct gold; small producers in 14 other counties shipped to smelters and to the San Francisco and Denver Mints.

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[6] Savage, C. N. Economic Geology of Central Idaho Blacksand Placers. Idaho Bureau of Mines and Geol., Bull. 17, 1961, 160 pp.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1952–56 (average)	112	28	2,218	16,731	$586	14,547	$13,166
1957	93	20	2,100	12,301	431	15,067	13,637
1958	85	31	1,681	15,896	556	15,953	14,438
1959	47	24	1,834	10,479	367	16,636	15,057
1960	79	20	1,105	6,135	215	13,647	12,351
1961	60	22	1,497	5,718	200	17,576	16,249
1863–1961[3]			141,317	8,300,913	193,671	734,791	553,330

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	4,690	$3,210	69,223	$20,318	62,175	$16,251	$53,531
1957	7,912	4,763	71,637	20,488	57,831	13,417	52.735
1958	9,846	5,179	53,603	12,543	49,725	10,144	42,860
1959	8,713	5,350	62,395	14,351	55,699	12,811	47,935
1960	4,208	2,702	42,907	10,040	36,801	9,495	34,802
1961	4,328	2,597	71,476	14,724	58,295	13,408	47,178
1863–1961[3]	175,000	73,482	7,012,000	962,659	2,275,000	467,188	2,250,330

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings, old slag re-treated, and ore shipped to smelters during the calendar year indicated. Because of rounding, individual items may not add to total shown.

[2] Does not include gravel washed.

[3] Partly estimated for years before 1901.

TABLE 8.—Gold production at placer mines

Year	Mechanical and hydraulic methods			Small-scale hand methods			Total		
	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)
1952–56 (average)	16	894	4,602	12	3	72	28	897	4,674
1957	16	250	2,916	4	2	49	20	252	2,965
1958	13	92	2,501	18	7	89	31	100	2,590
1959	10	92	1,878	14	5	89	24	98	1,967
1960	9	64	793	11	6	50	20	70	843
1961	[1] 8	60	488	14	9	53	22	69	541

[1] Includes 3 hydraulic operations, 2 dragline dredges, 1 bucket-line dredge, 1 nonfloat washing plant, and 1 ground-sluicing operation; combined to avoid disclosing individual company confidential data.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Blaine	5	----------	5	(1)	2,156	$2
Bonneville	----------	2	13	(1)	----------	----------
Butte	2	----------	3	(1)	966	1
Clearwater	----------	2	122	$4	19	(1)
Custer	13	1	574	20	161,489	149
Gem	1	----------	892	31	1,728	2
Idaho	3	4	81	3	24	(1)
Lemhi	12	2	220	8	3,063	3
Shoshone	15	1	3,282	115	17,369,240	16,058
Undistributed [2]	9	10	526	18	37,635	35
Total [3]	60	22	5,718	200	17,576,320	16,249

County	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Blaine	----------	----------	9	$2	11	$3	$7
Bonneville	----------	----------	----------	----------	----------	----------	(1)
Butte	----------	----------	1	(1)	----------	----------	1
Clearwater	----------	----------	----------	----------	----------	----------	4
Custer	481	$289	734	151	89	20	630
Gem	----------	----------	2	(1)	2	(1)	34
Idaho	----------	----------	----------	----------	----------	----------	3
Lemhi	3	2	62	13	9	2	27
Shoshone	3,673	2,204	70,651	14,554	58,184	13,382	46,313
Undistributed [2]	171	103	17	4	----------	----------	159
Total [3]	4,328	2,597	71,476	14,724	58,295	13,408	47,178

[1] Less than $500.

[2] Includes values and quantities that cannot be shown separately for Adams, Boise, Bonner, Boundary, Elmore, Jerome, Kootenai, and Valley Counties.

[3] Owing to rounding, individual items may not add to total shown.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold, gold old tailings, gold assay rejects, and gold mill cleanings [2]	13	2,406	1,088	2,115	--------	4,100	4,000
Dry silver and silver precipitates [2]	16	409,037	1,110	12,198,188	6,215,400	5,849,700	902,600
Total	29	411,443	2,198	12,200,303	6,215,400	5,853,800	906,600
Copper	6	20,866	564	22,319	1,268,200	9,100	200
Lead	20	165,561	1,408	2,543,899	564,000	31,994,600	2,629,200
Lead-zinc and zinc [2]	11	871,185	1,007	2,796,966	563,700	103,677,500	106,274,200
Total	37	1,057,612	2,979	5,363,184	2,395,900	135,681,200	108,903,600
Other lode material:							
Zinc: Old slag melted	1	27,600	--------	12,667	44,700	1,417,000	6,779,800
Total lode material	60	1,496,655	5,177	17,576,154	8,656,000	142,952,000	116,590,000
Gravel (placer operations)	22	([3])	541	166	--------	--------	--------
Total	82	1,496,655	5,718	17,576,320	8,656,000	142,952,000	116,590,000

[1] Because some mines produce more than one class of material, detail will not necessarily add to total shown.
[2] Combined to avoid disclosing individual company confidential data.
[3] 68,949 cubic yards.

TABLE 11.—Mine production of gold, silver, copper, lead, and zinc in 1961 by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation	509	341	--------	--------	--------
Concentration and smelting of concentrates	4,328	17,513,372	8,164,600	140,969,200	109,742,400
Total	4,837	17,513,713	8,164,600	140,969,200	109,742,400
Direct smelting:					
Ore, silver-precipitates and gold old tailings [1]	340	49,774	446,700	565,800	67,800
Old slag	--------	12,667	44,700	1,417,000	6,779,800
Total	340	62,441	491,400	1,982,800	6,847,600
Placer	541	166	--------	--------	--------
Grand total	5,718	17,576,320	8,656,000	142,952,000	116,590,000

[1] Combined to avoid disclosing individual company confidential data.

Iron Ore.—Production of iron ore was 33 percent above 1960; the increase was attributed to greater output at a Benewah County mine. Although considerable exploration and some development were in progress at various properties, no ore was produced from new operations. A small lot of previously mined magnetite sand was shipped from a stockpile in Valley County and two companies in Washington County mined and shipped lump magnetite ore. Lump ore went to steel mills and cement plants; the magnetite sand was used as heavy aggregate.

Lead.—State lead output, principally from Coeur d'Alene area mines, Shoshone County, increased 69 percent over the quantity produced in 1960; however, value increased only 49 percent because of a drop in the metal price. Passage by Congress during the year of a bill (Public Law 87–347) to provide aid to small-scale domestic lead-zinc producers stirred some hope for economic relief in the depressed lead-zinc industry.

Mercury.—Mercury production declined for the third consecutive year and was 30 percent below that of 1960. The Idaho-Almaden mine (Rare Metals Corporation of America) was the sole producer, operating until early December when the mine and mill were closed owing to a low metal price.

Silver.—Silver output gained 29 percent over that in 1960 and was the highest since 1938. Shoshone County yielded 99 percent of the total, principally from the Sunshine, Galena, Lucky Friday, Bunker Hill, Silver Summit, Crescent, Page, and Star mines. The Lucky Friday mine was idle approximately 3 months near the end of the year because of a labor-contract dispute; settlement was reached in mid-December. A similar strike was settled quickly at the Sunshine mine. Shares of silver-mining companies were traded actively during the year owing to an anticipated increase in the price of silver—an increase occurred in December when the Government announced cessation of silver sales from Federal reserves.

Thorium.—Exploration and development of thorite deposits in Lemhi and Boundary Counties, begun in 1960, continued although there was no market for the ore. Properties of Northwest Prospecting & Development Co. on Hall Mountain north of Bonners Ferry, Boundary County, were leased by four Spokane (Wash.) men. Rare Metals Corporation of America continued work on claims leased from Agency Creek Thorium & Rare Metals Corp. In Lemhi County, Nuclear Fuels & Rare Metals Corp. mined ore for a test run at a mill leased from Salmon River Uranium Development Corp. Also in Lemhi County, claims were explored on Agency and Potter Creeks.

Titanium.—Stockpiled ilmenite dredge concentrate was sold by Porter Bros. Corp. and J. R. Simplot Co., both of Boise, Idaho, for use in high-density concrete and as roofing granules. The concentrate was recovered from ores mined in Valley County.

Tungsten.—Development continued at the Salmon River Scheelite Corp. Thompson Creek property, Custer County. A small trial lot of concentrate was shipped to Minerals Engineering Co., Glen, Mont.; however, market conditions were unfavorable for profitable shipments. The mine was subleased to Barretts Investment Co., Salt Lake City, Utah. American Metal Climax leased the Ima tungsten mine, Lemhi County, which had been closed in 1957. Claims held by Howe Sound Co. adjacent to the Ima also were leased. A 10-man crew sampled the properties.

Uranium.—Compared with 1960, the quantity of uranium ore shipped declined 41 percent; value dropped 66 percent because ore of considerably lower grade was mined.

Vanadium.—Vanadium-bearing ferrophosphorus slag resulting from the electric-furnace production of elemental phosphorus at the FMC Corp., Minerals Products Division, Power County plant, yielded high-purity vanadium pentoxide. The slag was processed at a Garfield (Utah) plant where a 99.5-percent-pure metal oxide was recovered.

Zinc.—Zinc output increased 58 percent compared with 1960 production, which was curtailed by an extended labor dispute. However, a lower average annual price yielded only a 41-percent rise in value. The Star, Bunker Hill, and Page mines, Shoshone County, supplied most of the tonnage. A bill to provide a subsidy to certain small lead-zinc producers was passed by Congress, but no funds were made available to put the program into effect.

NONMETALS

Barite.—The Sun Valley mine of J. R. Simplot Co., Blaine County, was idle; however, shipments of crude barite were made from stocks at the mine to the company grinding plant in Power County, west of Pocatello. Shipments of ground barite, marketed as a weighting agent for oil-well drilling mud, were down sharply compared with 1960.

Cement.—Idaho Portland Cement Co. continued to produce portland and masonry cements at Inkom, Bannock County. Production and shipments of portland cement increased 7 and 8 percent, respectively, over 1960. Shipments were mainly to destinations within the State with smaller quantities marketed in other Rocky Mountain States.

Clays.—The quantity of clay sold or used by Idaho producers declined 24 percent from 1960. Curtailed production of miscellaneous clay for making heavy clay products, mainly building brick, was the principal cause for the sharp drop. Fire clay output also declined. Miscellaneous clay was mined in Bonneville, Cassia, Elmore, and Minidoka Counties. Fire clay for refractories was produced in Latah County.

A small tonnage of bentonite mined near Grandview, Owyhee County, was used as a hydroseal for irrigation canals and reservoirs and in oil-well drilling mud. Production was greater than in 1960.

Initial shipments of clay for paper and refractories were made from the J. R. Simplot Co. Miclasil plant near Bovill, Latah County. The installation, completed in 1960, was built to beneficiate a plant feed consisting of a mixture of clay, quartz, and mica to products suitable for use by the paper, refractories, and glass industries in the Pacific Northwest.

Garnet (Abrasive).—Production and shipments of abrasive garnet by Idaho producers were substantially greater than in 1960. Principal output was from two operations in Benewah County. Porter Bros. Corp., Boise County, and J. R. Simplot Co., Ada County, also shipped garnet that was obtained as a byproduct from milling black sand concentrates previously produced from respective company operations in Valley County.

Gypsum.—There was no production of gypsum in 1961. Shipments of agricultural gypsum were made from stocks at the Rock Creek mine (Rock Island Gypsum Co.) northwest of Weiser, Washington County.

Russett Mining & Manufacturing Corp. did assessment work on gypsum claims north of Weiser.

Lime.—There was no production of lime for open market sale by commercial firms; however, captive production (for interplant use) of lime at sugar refineries totaled 46,760 tons. A quantity of lime also was recovered and recycled at a kraft-paper plant.

Mica.—No production or shipments of mica were recorded in 1961. Ida-Mica Industrial Minerals, Inc., carried on development at the Muscovite mine near Deary, Latah County, and constructed a mica-grinding mill at the mine site. Initially, scrap mica from mine dumps was to be used as a raw material for the mill scheduled to become operative in 1962.

Peat.—Peat production was 14 percent lower than in 1960. Output from an operation near Downey in Bannock County, was marketed mainly for soil-conditioning.

Perlite.—Oneida Perlite Corp. began mining crude perlite at deposits north of Malad. The ore, mined by open-pit methods, was trucked to a nearby crushing, screening, and drying plant. A dried product, sized in six fractions, was shipped from the mill to the company storage and expanding facilities at Malad. Bulk shipments of crude perlite were made to commercial expanding plants in the United States and Western Canada, and a portion of the crude mineral was processed at the company expanding plant.

Phosphate Rock.—Production of marketable phosphate rock by Idaho producers was 1.4 million long tons, compared with 2.2 million long tons in 1960. Crude phosphate rock mined totaled 1.6 million long tons—a drop of 27 percent from the previous year. Four operations—two in Caribou County and one each in Bear Lake and Bingham Counties—contributed to the production. Output at all mines was reduced compared with 1960. In addition, the Diamond Gulch (Caribou County) and Waterloo (Bear Lake County) mines of San Francisco Chemical Co. were idle throughout the year. Shipments to fertilizer manufacturers were made from stocks at the Diamond Gulch mine during the first half of the year.

Phosphate rock sold or used by producers totaled 1.7 million long tons compared with 2 million long tons in 1960. Elemental phosphorus plants continued to consume the largest tonnage; following, in order of tonnage, were consumption in making superphosphate and wet-process phosphoric acid, and exports. Consumption in all categories was less than in 1960.

Elemental phosphorus was made at plants of FMC Corp., Mineral Products Division (formerly Food Machinery & Chemical Corp.), Pocatello; Monsanto Chemical Corp., Soda Springs; and Central Farmers Fertilizer Co., Georgetown. The latter firm utilized its elemental phosphorus for manufacturing phosphoric acid and phosphate fertilizers at the company Georgetown works.

J. R. Simplot Co. continued manufacturing phosphate fertilizers and wet-process phosphoric acid at a plant west of Pocatello in Power County. Simplot also continued an expansion program begun in 1960 at its fertilizer works. Included in the expansion was purchase from The Anaconda Company of an ammonium-phosphate fertilizer plant which was dismantled and moved from Anaconda, Mont., to

Pocatello during the year. Erection of the new facility was completed in November and production of ammonium-phosphate fertilizers was begun. Additional phosphoric acid capacity also was installed at the fertilizer works as well as new screening, pelletizing, and bagging equipment; a plantwide water-reclaiming system; and additional fertilizer storage facilities.

In February initial shipments of fertilizer-grade phosphoric acid were made from the newly constructed fertilizer plant of The Bunker Hill Co., Kellogg, Shoshone County. The plant, which had been completed in 1960 but had remained idle awaiting settlement of a labor dispute, was operated intermittently throughout 1961 because of fluctuating demand. Storage capacity for an additional 2,000 tons of phosphoric acid was constructed at Kellogg to achieve more continous operation of the plant. In March, construction of the Collier Carbon & Chemical Corp. acid-concentrating plant, adjacent to the Bunker Hill Phosphoric acid facility was completed. The Collier plant was to upgrade standard-test phosphoric acid obtained from Bunker Hill to a more concentrated product. Operation in 1961 was on a test-run basis. Output was to be shipped to Collier fertilizer plants in California.

FMC Corp. completed a $3 million expansion program begun in 1960 at its Pocatello elemental-phosphorus plant and announced plans for increasing the productive capacity of the plant 20 percent more over the next 2 years.

In November, International Minerals & Chemical Corp. and Husky Oil Co. announced plans for exploration and development of phosphate deposits near Soda Springs, Caribou County. The agreement reportedly was to allow up to 5 years for developing a final plan for undertaking the joint venture. International Minerals was a large producer and processor of Florida phosphate rock.

Pumice and Volcanic Cinder.—Pumice and volcanic cinder sold or used by producers advanced 9 percent over 1960. Output was largely from established operations in Bonneville County; production also was reported from Canyon (volcanic cinder) and Twin Falls (pumice) Counties. Pumice and cinder production was used mainly as lightweight-concrete aggregate; a quantity of crude pumice was used for surfacing roads.

Sand and Gravel.—Sand and gravel produced for all purposes totaled 7.3 million tons, an increase of 3 percent over 1960. The quantity of sand and gravel (3.5 million tons) used at State highway projects, 13 percent higher than in 1960, was the principal reason for the increased total. Sand and gravel produced by commercial firms was 2.2 million tons compared with 2.5 million tons in 1960. Government-and-contractor production (largely by contractors for Federal, State, county, and municipal agencies) was 5.1 million tons, an increase of 11 percent over that of 1960. Production came from operations in 34 of the 44 counties. Cassia County ranked as the leading producer; Bingham and Ada Counties ranked second and third, respectively.

TABLE 12.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	775	$1,125	821	$1,130
Road material	1,503	1,266	1,187	1,129
Fill	--------	--------	81	44
Other [1]	208	226	108	114
Total	2,486	2,617	2,198	2,417
Government-and-contractor operations:				
Building	76	73	--------	--------
Road material	4,244	3,791	4,911	4,300
Fill	282	113	196	75
Total	4,602	3,977	5,107	4,376
All operations:				
Building	851	1,198	822	1,130
Road material	5,747	5,057	6,099	5,429
Fill	--------	--------	276	119
Other [1]	490	339	108	114
Grand total [2]	7,088	6,594	7,305	6,793

[1] Includes special sands, railroad ballast, and sand and gravel used for miscellaneous purposes.
[2] Owing to rounding, individual items may not add to totals shown.

Specially prepared sands for glass, plaster, foundry, and abrasive purposes were produced in Gem and Latah Counties.

Stone.—Production of stone for all purposes totaled 1.9 million tons, an advance of 42 percent over the 1.3 million tons produced in 1960. The rise resulted from increased quantities of crushed stone used at State and Federal road projects. Stone output by commercial concerns was 500,000 tons and Government-and-contractor production was 1.4 million tons compared with 660,000 and 650,000 tons, respectively, in 1960. Basalt and granite, greatest in tonnage output, were used chiefly for road construction and maintenance purposes. Smaller quantities were used for railroad ballast and riprap. The quantity of limestone produced declined sharply owing to closure of a quarry in Lewis County. Output from a quarry in Bannock County was used for cement manufacture. Quartzite quarried in Caribou and Power Counties was utilized as flux in electric furnaces at elemental-phosphorus plants. The quantity produced for this purpose was less than in 1960. Stone production was reported from 17 counties.

Sulfuric Acid.—The Bunker Hill Co. continued production of sulfuric acid at Kellogg, Shoshone County. Sulfur dioxide gases generated in roasting zinc concentrates at the adjacent company electrolytic-zinc plant were used in making the sulfuric acid. Production and sales increased sharply over 1960 when output was reduced drastically as a result of labor dispute. The acid was used mainly for manufacturing phosphate fertilizers and for metallurgical use at the company electrolytic-zinc plant. J. R. Simplot Co., Minerals and Chemical Division, continued producing sulfuric acid at a plant west of Pocatello in Power County, for use in manufacturing phosphatic fertilizers and wet-process phosphoric acid at the adjacent company fertilizer works. Byproduct sulfur recovered at plants in Montana and Wyoming was the basic raw material used at the plant.

REVIEW BY COUNTIES

Mineral production for 1961 was reported from 41 of the 44 counties. Shoshone County accounted for 68 percent of the total mineral-output value. Sand and gravel and stone were the principal or only products from 14 counties. In the following review, only those counties with significant mineral industry activities will be discussed.

Ada.—Sand and gravel for construction and road use was produced at nearly double the 1960 rate. Increased requirements at county highway projects accounted for the sharp increase.

Adams.—Ore averaging about 17 percent copper was produced at the Peacock mine near Cuprum. Western Mines, Inc., employed five men at the open-pit operation, and ore was shipped to the Tacoma (Wash.) smelter.

Bannock.—Idaho Portland Cement Co. continued to produce portland and masonry cements at Inkom. Limestone, the principal raw material used at the plant, was obtained from the nearby company-operated Inkom quarry. Smaller quantities of purchased silica, gypsum, and iron ore also were utilized. Idaho Peat, Inc., produced a small tonnage of reed-sedge peat near Downey. Sand and gravel output advanced about threefold, and stone production increased 16 percent over 1960.

Bear Lake.—The value of mineral production dropped sharply as smaller quantities of phosphate rock, sand and gravel, and stone were reported produced. Mine production of phosphate rock also declined compared with 1960 as Central Farmers Fertilizer Co. reduced output at the company Georgetown Canyon mine. The firm used phosphate rock to manufacture elemental phosphorus, phosphate fertilizers, and phosphoric acid at its nearby fertilizer works. Some phosphate rock was shipped for export.

There was no production or shipment of phosphate rock from the Waterloo mine of San Francisco Chemical Co. near Montpelier.

Benewah.—Idaho Garnet Abrasive Co. and Emerald Creek Garnet Milling Co. produced and shipped garnet from operations near Fernwood. Output was for airblast abrasive use. Two producers quarried and crushed basalt to supply roadstone for the State highway department.

Bingham.—In terms of tonnage, Bingham County continued as the leading phosphate rock producing area in the State, despite a sizable reduction in the quantity mined. Production of both phosphate rock and phosphatic shale at the Gay mine (J. R. Simplot Co.) near Fort Hall was less than in 1960. The phosphate rock was used in manufacturing phosphatic fertilizers at the Simplot fertilizer works in Power County. The lower grade phosphatic shale was shipped to FMC Corp., Pocatello, for conversion to elemental phosphorus.

Blaine.—The Urite Mining Co. Edress silver mine was the principal producer in the Mineral Hill mining district. Ore was shipped to a mill at Midvale, Utah. Idaho Mining Co. and Anthony Vitale oper-

TABLE 13.—Value of mineral production in Idaho, by counties

(Thousand dollars)

County	1960	1961	Minerals produced in 1961 in order of value
Ada	(1)	$500	Sand and gravel.
Adams	(1)	(1)	Copper, silver, gold.
Bannock	(1)	(1)	Cement, sand and gravel, stone, peat.
Bear Lake	(1)	(1)	Phosphate rock, sand and gravel.
Benewah	$212	168	Abrasive garnet, stone, iron ore.
Bingham	(1)	(1)	Phosphate rock, sand and gravel.
Blaine	(1)	36	Barite, stone, zinc, silver, lead, sand and gravel, gold.
Boise	35	(1)	Gold, silver.
Bonner	107	151	Sand and gravel, silver, stone, gold, lead.
Bonneville	462	599	Sand and gravel, lime, pumice, clays, stone, gold.
Boundary	99	79	Sand and gravel, lead, silver.
Butte	(1)	225	Sand and gravel, silver, lead, gold.
Camas	80	39	Sand and gravel.
Canyon	232	465	Sand and gravel, lime, pumice.
Caribou	(1)	(1)	Phosphate rock, stone, sand and gravel.
Cassia	957	711	Sand and gravel, clays.
Clark	36	77	Sand and gravel.
Clearwater	188	179	Stone, gold, silver.
Custer	549	650	Copper, lead, silver, zinc, gold, uranium, tungsten.
Elmore	196	91	Sand and gravel, clays, gold, silver.
Franklin	112	240	Sand and gravel, lime.
Freemont	27	80	Sand and gravel, stone.
Gem	214	194	Sand and gravel, gold, silver, zinc, lead.
Gooding	(1)	74	Sand and gravel.
Idaho	419	1,164	Stone, sand and gravel, gold, silver.
Jefferson	-----------	28	Sand and gravel.
Jerome	204	19	Sand and gravel, gold.
Kootenai	300	215	Sand and gravel, stone, silver.
Latah	153	611	Stone, sand and gravel, clays.
Lemhi	1,002	160	Sand and gravel, lead, gold, silver, zinc, copper, stone.
Lewis	297	64	Stone, sand and gravel.
Lincoln	(1)	-----------	
Madison	(1)	392	Sand and gravel, stone.
Minidoka	171	441	Lime, sand and gravel, clays, stone.
Nez Perce	21	66	Sand and gravel.
Oneida	45	74	Recycled lime, sand and gravel, perlite.
Owyhee	348	79	Sand and gravel, clays.
Payette	37	-----------	
Power	272	462	Vanadium, sand and gravel, stone.
Shoshone	33,393	46,691	Silver, lead, zinc, copper, antimony, sand and gravel, gold, stone.
Teton	(1)	-----------	
Twin Falls	267	318	Sand and gravel, pumice.
Valley	35	(1)	Titanium (ilmenite), abrasive garnet, gold, iron ore, silver.
Washington	840	(1)	Mercury, iron ore.
Undistributed [2]	16,131	13,558	
Total	57,441	68,900	

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes value of gem stones and some sand and gravel, and stone that cannot be assigned to specific counties and values indicated by footnote 1. Excludes value of raw materials used in manufacturing cement and lime.

ated silver mines in the same district. The Bing mine and the Wilkes Associates property yielded lead-zinc ore.

The Sun Valley barite mine (J. R. Simplot Co.) was not operated during 1961. Sand and gravel and crushed stone were produced for road construction and maintenance purposes.

Boise.—Minor quantities of lead and gold ore were produced from the Come Back (Come-Back Mining Co.) and Cracker Jack (Donmar Gold Mines Co.) mines in the Boise Basin mining district. Ore from the King mine, Summit Flat district, yielded a small quantity of gold and silver. Gold assay rejects from the Adelmann Assay Office, Boise, also contributed to the county production value.

Bonner.—A sizable tonnage of silver ore was extracted at the Austin-Meyer Corp. Weber mine, Lakeview mining district. Crude ore was shipped to the Tacoma (Wash.) smelter. The Lawrence mine, Clark Fork mining district, and the Brown Bear mine, Pend Oreille mining district, yielded small tonnages of lead and copper ore, respectively.

Bonneville.—Pumice production from operations near Idaho Falls continued to supply the bulk of the State total. Output increased substantially over that of 1960. Clay for manufacturing heavy clay products, mainly building brick, was mined near Idaho Falls. Reduced requirements for sand and gravel at county, State, and Federal road projects resulted in a sharp drop in the production of these commodities compared with 1960.

A report on the geology and mineral resources of the county was published during the year.[7]

Caribou.—Two phosphate mines were active in the county compared with three in 1960. Phosphate rock mined at the Ballard property of Monsanto Chemical Co. was moved by truck 11 miles over a private haulage road to the company elemental phosphorus plant at Soda Springs. Production from the Conda mine was shipped to the Simplot company Pocatello fertilizer plant. A major portion of the Conda mine production was beneficiated before shipment. Output from both the Conda and the Ballard properties was substantially less than in 1960. The Diamond Gulch mine of San Francisco Chemical Co., which began operating in 1960, was idle.

Clearwater.—Moose Mountain Mining Co. recovered 121 ounces of placer gold using a dragline at the Lilly No. 1 and No. 2 claims, Moose Creek mining district.

Custer.—The Clayton Silver Mines Clayton mine, Bayhorse mining district, was the principal metal mine in the county, and yielded silver-lead ore. According to the company annual report to stockholders, the mine was operated 6 days and the mill 7 days a week throughout the year. Seven diamond drill holes averaging 500 feet each were driven into the foot and hanging walls of the Clayton ore zone, resulting in defining an additional ore zone in the foot wall, northwesterly from existing orebodies. Ore reserves were estimated by the company to be in excess of 200,000 tons. The Clayton mine was eligible to receive aid under the Small Mines Aid Bill. At the main shaft of the mine, a new 75-horsepower hoist was installed. In addition to the exploratory diamond drilling, the company raised 109 feet, drifted 43 feet, and crosscut 40 feet during the year. The ore deposit was mined by shrinkage stoping.

A sizable tonnage of copper ore was mined from the R. V. Lloyd & Co. Empire group, Alder Creek district, 5 miles southwest of Mackay. Minor quantities of lead and silver were produced at 11 other mines.

Limited development continued at the Salmon River Scheelite Corp. Tungsten Jim mine near Clayton. The company mined 300 tons of ore averaging 1.8 percent tungsten trioxide. The ore was concentrated at a small pilot mill near the property and the concentrate was shipped to a tungsten producer in Montana.

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[7] Savage, C. N. Geology and Mineral Resources of Bonneville County. Idaho Bureau of Mines and Geol., County Rept. No. 5, 1961, 48 pp.

Geology of the county was the subject of a report.[8]

Elmore.—Talache Mines, Inc., operated the Boise-Rochester group and shipped gold concentrate to the Tacoma (Wash.) smelter and gold bullion to the San Francisco Mint. Feather Placers, Bear Creek district, produced a small quantity of placer gold.

Gem.—Gem State Consolidated Mines, Inc., operated the Dewey group in the Westview mining district and recovered nearly 900 ounces of gold in addition to silver, lead, and zinc.

The geology and mineral resources of the county were reported.[9]

Idaho.—Small quantities of gold were recovered at the Mammoth, Crown Point, and Wild Hope lode mines. Four small gold placers—Golden Boy No. 1 and No. 2, Maloney Creek, Pixie No. 1, and Gold Fever—were operated.

Latah.—Clay for paper and refractories use was processed at the J. R. Simplot Co. Miclasil plant near Bovill. A major part of the silica sand produced as a coproduct at the operation was shipped to glass-container-manufacturing plants in the Pacific Northwest. Raw material for the plant was obtained from nearby clay-silica deposits owned and operated by the Simplot company. Fire clay refractories were manufactured at Troy by A. P. Green Firebrick Co. from clay mined near Helmer. Sand and gravel and crushed stone for construction and road purposes also were produced. Crushed stone output increased sharply over that of 1960 owing to State highway department projects underway in the county.

Lemhi.—The Texas mining district Mountain Boy, Rosebud, and United Idaho mines yielded lead ore and accounted for most of the county metal production value.

County geology and mineral resources were described.[10]

Oneida.—Mining and processing of perlite from deposits northwest of Malad, was begun by Oneida Perlite Corp. A part of the output was expanded at the company plant and marketed principally for building-plaster aggregate, loose-fill insulation, soil conditioning material, and concrete aggregate.

Power.—Phosphate rock, mined by J. R. Simplot Co. at its Gay mine north of Pocatello and at the Conda mine in Caribou County, was used in manufacturing phosphatic fertilizers and wet-process phosphoric acid. Phosphatic shale produced at the Gay mine (Bingham County) was reduced to elemental phosphorus at the electric furnace plant of FMC Corp. Elemental phosphorus was shipped by rail to company chemical plants in California and the Midwest. Quartzite used as a flux in electric furnaces at elemental phosphorus plants was quarried near Pocatello. Sand and gravel and crushed stone for construction and road purposes also were produced.

Shoshone.—In value of production, Shoshone County mines supplied 98 percent of Idaho's silver, lead, zinc, copper, and gold output (listed in order of value). Value of these metals, 40 percent more than in 1960, was the highest for the county since 1957.

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[8] Williams, Paul L. Glacial Geology of the Stanley Basin. Idaho Bureau of Mines and Geol., Pamph. 123, 1961, 45 pp.

[9] Savage, C. N. Geology and Mineral Resources of Gem and Payette Counties. Idaho Bureau of Mines and Geol., County Rept. No. 4, 1961, 50 pp.

[10] Anderson, A. L. Geology and Mineral Resources of the Lemhi Quadrangle, Lemhi County. Idaho Bureau of Mines and Geol., Pamph. 124, 1961, 50 pp.

The Bunker Hill Co. began producing fertilizer-grade phosphoric acid at a newly constructed plant near Kellogg. In its annual report to shareholders, the company reported shipments of 13,500 tons of fertilizer-grade phosphoric acid during the year. Phosphate rock from Wyoming and sulfuric acid produced at the nearby company metallurgical works were the principal raw materials utilized at the plant. Collier Carbon & Chemical Corp., in March, completed an acid concentrating plant at Kellogg. Production-scale test runs were made during the year.

Geology of the Coeur d'Alene area was the subject of a report.[11]

Beaver District.—Ore was mined at the Mountain Goat property, only producing mine in the district. Work was by lessees for Day Mines, Inc.

TABLE 14.—Mine production of gold, silver, copper, lead, and zinc, in the Coeur d'Alene region, Shoshone County, in terms of recoverable metals

Year	Mines producing		Material sold or treated (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
	Lode	Placer							
1952-56 (average)	43	2	1,812	2,128	13,587	2,411	64,414	58,993	$48,288
1957	31		1,701	2,254	14,398	3,473	67,125	54,825	47,117
1958	25		1,337	2,363	15,615	3,884	52,488	49,532	38,645
1959	17	1	1,422	2,349	16,461	3,678	61,155	55,454	44,058
1960	22	1	980	2,591	13,459	2,606	41,692	36,639	33,153
1961	15	1	1,434	3,279	17,369	3,673	70,651	58,184	46,313
1884-1961			(1)	431,000	635,199	102,000	6,542,000	2,145,000	1,865,365

[1] Complete data not available; 1904-61, 106,505,081 short tons.

Evolution District—Silver ore production by Hecla Mining Co. from the Silver Summit mine was about the same as in 1960; however, the ore yielded nearly 2.5 ounces of silver a ton more. Ore reserves at yearend were sufficient for only 6 months' continued operation, according to the company's annual report to shareholders.

The Sunshine Mining Co. Sunshine mine (comprising the Unit, Sunshine, Rambo, Suncon, and Yankee Girl properties) yielded 188,923 tons of ore averaging 32.46 ounces of silver a ton, giving a total output of over 6 million ounces. The Sunshine company annual report to shareholders stated the following:

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[11] Idaho Bureau of Mines and Geology. Guidebook to the Geology of the Coeur d'Alene Mining District, ed. by Rolland R. Reid. Bull. 16, 1961, 37 pp.

> The sandfill system of stope filling has permitted "cleaner" mining and less dilution with the result that from fewer tons of ore of higher grade, nearly the same number of ounces of silver were produced in 1961 as in 1960. As expected, the system has reduced timber requirements and provided better control of grade by the elimination of waste rock.

A new wage contract was negotiated between Sunshine and United Steelworkers of America in October, following a short strike. The contract provided a wage increase of 6 cents an hour and changes in the employee health and welfare program.

Concerning development, the Sunshine annual report further stated:

> Drift development was limited to the Unit Area, primarily on the Chester fault-vein and on the "D" vein. The Chester fault was developed to the east a total of 2,425 feet on the 3700, 3850, and 4000 levels with 737 feet of new ore exposed. Drifting to the West on the "D" vein on 3400 and 3700 levels developed 460 feet of narrow high-grade ore. In addition to other minor vein development, 1634.4 feet of crosscutting and 660.7 feet of raising were done in conjunction with the new No. 10 shaft, which was sunk 262 feet below the 4000 level. Approximately 1350 feet in strike length on the Chester fault was added to the Unit Area for operation by Sunshine Mining Company under an agreement with neighboring companies to the east of the Sunshine mine.

Sunshine Mining Co. stocks of cathode antimony metal were reduced to 346,903 pounds at yearend. Sales totaled 3,292,655 pounds.

Hunter District.—Two properties, the Lucky Friday (lead) and the Star (lead-zinc) mines, were active in the district. Although inactive, a minor tonnage of ore was shipped from stock at the Golconda mine, Mayflower lease.

Hecla Mining Co. operated the Lucky Friday Silver-Lead Mines Co. Lucky Friday mine (approximately 38 percent of outstanding shares of the Lucky Friday company were held by Hecla). Because of a strike, the Lucky Friday mine and mill were closed from September 16 until December 11, when a contract was signed by the company and the United Steelworkers of America. During 1961, the company milled 128,860 tons of ore averaging 19.41 ounces of silver a ton and 11.29 percent lead.

Hecla Mining Co. and the Bunker Hill Co. signed an agreement in July that gave Hecla a 30-percent interest in ownership of the Star mine. Hecla previously operated the Star for The Bunker Hill Co. on a fee basis. The Morning mine adjoining the Star was leased from American Smelting and Refining Co. and was to be worked through the Star; the combined operation was named Star Unit Area.

Placer Center District.—The Day Mines, Inc., Dayrock, Interstate-Callahan, and Tamarack No. 5 mines yielded lead ore, and the American Smelting and Refining Co. Galena mine (25 percent controlled by Day Mines, Inc.) yielded silver ore. Day Mines, Inc., annual report to stockholders stated the following:

> Dayrock operations were divided between 800 feet of drifting westerly on the 1100 level along the Hornet vein, and stoping the Bonanza vein on the 500 level. Lessees of the Tamarack mine produced a small tonnage from above the No. 7 Adit. Lessees of the Mountain Goat mine . . . added a "sink-float" plant to their mill to permit reworking old stope fill from the Interstate-Callahan mine.

Day also reported that development at the Galena property North vein added rich but narrow ore to the reserves. Doubling ventilation capacity in the Galena mine resulted from sinking a new shaft from the surface to the 2,400 level.

Smelter District.—The Bunker Hill Co. fumed over 27,000 tons of zinc-dump slag that yielded 708 tons of lead and 3,390 tons of zinc.

Yreka District.—The Bunker Hill Co. Bunker Hill mine and five leased properties (Clements, Hedgecorth, McLin, Marr, and Thompson) yielded lead ore, dominating the district metals output. Also, the Crescent silver mine was operated by Bunker Hill. American Smelting and Refining Co. mined a substantial tonnage of lead-zinc ore at the Page property.

A sand-fill system was installed at the Bunker Hill mine, and approximately 90 percent of the stopes were being sand filled at the end of the year.

Valley.—Dredging operations of Porter Bros. Corp. at Bear Valley were idle but in operational readiness. The Porter company investigated the commercial-production feasibility of columbium and tantalum from euxenite. Stock-piled magnetite sand, recovered by Porter Bros. Corp. when the Bear Valley dredges and Lowman sand-separation plant were operating, was marketed; 3,500 tons remained in the stockpile at the Lowman plant site. Also marketed were ilmenite (titanium-bearing mineral) as roofing granules and gold recovered earlier in extremely minor amounts from the Bear Valley alluvium.

Washington.—The one mercury producer in Idaho and the last significant producer in the Pacific Northwest, the Rare Metals Corporation of America Idaho-Almaden mine and mill ceased operations December 5 owing to the low price of mercury. The company furnaced over 53,000 tons of ore during the year and recovered 1,073 flasks of mercury.

Iron ore was shipped from two mines, one operated by George Budock near Cambridge and another, the Mortimore mine, worked part of the year by Glen Clark. The latter property was sold to Joe Holcomb who also mined the property.

Rock Island Gypsum Co. shipped agricultural gypsum from stocks at the Rock Creek mine north of Weiser. Shipments were less than in 1960.

The Mineral Industry of Illinois

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Illinois State Geological Survey.

By Matthew G. Sikich[1] and L. G. Marshall[2]

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MINERAL production in Illinois in 1961 was valued at $571.6 million, about 3 percent below the record high established in 1960. Decreases in values of output for portland cement, clays, coal, fluorspar, natural gas, natural gas liquids, sand and gravel, stone, tripoli, and zinc were not offset by increases for masonry cement, lead, lime, peat, and petroleum. Mineral fuels were 76 percent of the total value of State mineral output; nonmetals were 23 percent; and metals, 1 percent.

TABLE 1.—Mineral production in Illinois[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland — thousand 376-pound barrels	8,770	$29,321	8,595	$28,301
Masonry — thousand 280-pound barrels	[2] 496	1,411	461	1,420
Clays — thousand short tons	2,357	5,479	1,982	4,166
Coal (bituminous) — do	45,977	184,087	45,246	177,070
Fluorspar — short tons	134,529	6,936	116,908	5,956
Lead (recoverable content of ores, etc.) — do	3,000	702	3,430	707
Natural gas — million cubic feet	11,666	1,458	9,970	1,276
Natural gas liquids:				
Natural gasoline and cycle products — thousand gallons	16,496	1,313	16,956	1,311
LP gases — do	358,366	19,941	340,284	16,495
Peat — short tons	6,179	28	6,597	30
Petroleum (crude) — thousand 42-gallon barrels	77,341	228,929	[3] 79,387	[3] 237,367
Sand and gravel — thousand short tons	33,138	36,255	31,353	35,098
Stone — do	41,721	55,593	36,361	47,939
Zinc (recoverable content of ores, etc.) — short tons	29,550	7,624	26,795	6,163
Value of items that cannot be disclosed: Gem stones, lime, and tripoli		[4] 10,797		11,775
Total Illinois[5]		[4] 586,364		571,605

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Previously reported in 376-pound barrels.
[3] Preliminary figure.
[4] Revised figure.
[5] Total adjusted to eliminate duplicating value of clays and stone.

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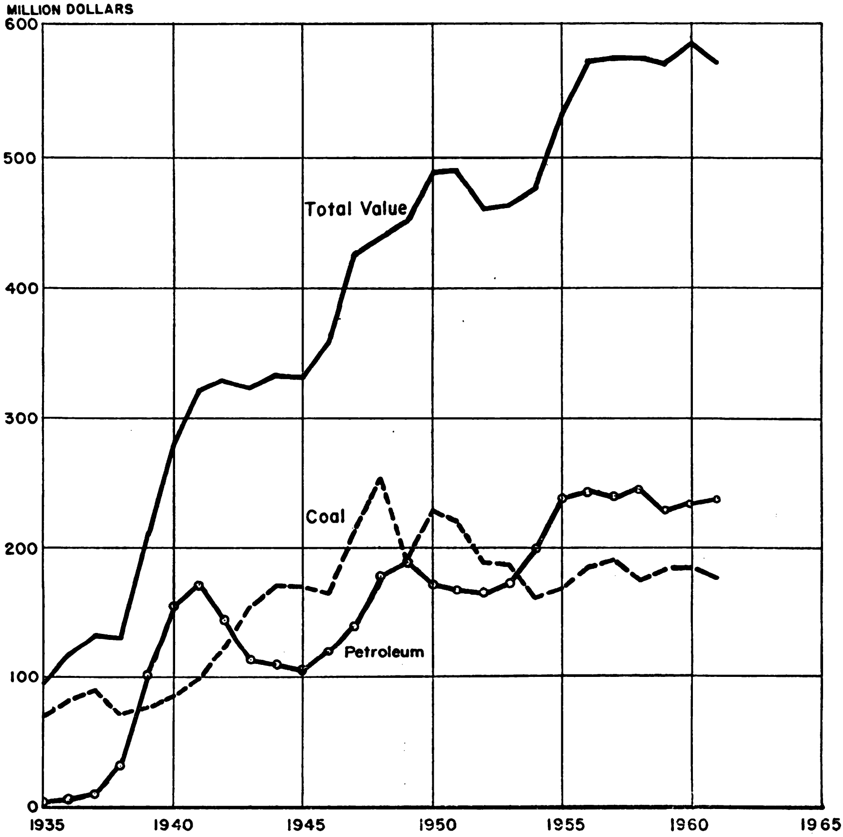

FIGURE. 1.—Value of coal, petroleum, and total value of mineral production in Illinois, 1935–61.

Illinois continued to rank high in national mineral production. In 1961, the State led in output of fluorspar, and ranked third in stone, fourth in bituminous coal, and fifth in sand and gravel output. Illinois also ranked high in raw materials processing.

Employment and Injuries.—Approximately 33.1 million man-hours were worked in Illinois mineral industries in 1961, excluding office-workers and employees of the entire petroleum industry. This was nearly a 10-percent decrease from the final figure of 36.6 million man-hours recorded for 1960. Injury experience improved over the previous year. A total of 8 fatal and 889 nonfatal disabling injuries was reported, compared with 15 fatal and 956 nonfatal disabling injuries in 1960. Table 2 contains a summary of employment and injury statistics for selected State mineral industries. Certain industries are excluded from the table, primarily to avoid disclosing individual company confidential data.

TABLE 2.—Employment and injuries for selected mineral industries[1]

Year and industry	Average number of men working	Total man-hours	Total number of disabling injuries		Injury frequency rate[2]
			Fatal	Nonfatal	
1960:					
Cement[3]	908	2,348,220	----------	2	0.85
Clays[4]	1,337	2,247,065	2	76	34.71
Coal (bituminous)	9,773	16,494,104	10	584	36.01
Coke ovens	711	1,840,788	----------	7	3.80
Fluorspar	537	1,037,901	----------	22	21.20
Limestone[5]	2,549	5,179,770	----------	138	26.64
Sand and gravel	1,970	3,912,728	2	77	20.19
Smelters	1,227	2,643.660	----------	32	12.10
1961:[6]					
Cement[3]	829	2,166,301	----------	2	.92
Clays[4]	1,144	1,999,824	----------	72	36.00
Coal (bituminous)	8,983	14,729,376	7	564	38.77
Coke ovens	573	1,671,130	----------	6	3,59
Fluorspar	535	1,035,747	----------	35	33.79
Limestone[5]	2,440	4,806,385	----------	109	22.68
Sand and gravel	1,954	3,639,710	1	43	12.09
Smelters	978	2,232,941	----------	41	18.36

[1] Excludes officeworkers.
[2] Total number of injuries per million man-hours.
[3] Includes cement plants and quarries or pits producing raw material used in manufacturing cement.
[4] Excludes pits producing clay used exclusively in manufacturing cement.
[5] Excludes quarries producing limestone used exclusively in manufacturing cement and lime.
[6] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Illinois ranked fourth in coal production in the Nation although output declined 2 percent in quantity and 4 percent in value, compared with that of 1960. Increases in consumption by electric-power utilities and coke and gas plants failed to offset decreases in demand by general manufacturing and processing industries, domestic consumers, and railroads. Nearly three-fifths of coal output, about 27 million tons, was used for producing electric energy. Shipments to coke and gas plants increased about 100,000 tons over 1960. Sales for railroad fuel declined to less than 400,000 tons. Within the past decade, consumption by railroads had dwindled to less than 1 percent of the total State production. Approximately 72 percent of the 37.5 million tons of coal consumed in Illinois in 1961 was mined within the State. Value at the mine was $3.91 per ton, compared with $4.00 in 1960.

Coal was produced from 114 mines in 37 counties, compared with 128 mines in 33 counties in 1960. Data exclude mines producing less than 1,000 tons annually. The leading counties in decreasing order of production were Williamson, Fulton, Christian, St. Clair, Franklin, Saline, Jefferson, Perry, Montgomery, Knox, Randolph, Vermilion, and Jackson. Nine companies each produced over 1 million tons and together furnished 81 percent of the State output. The Peabody Coal Co. No. 10 and River King mines and the Freeman Coal Mining Corp. Orient No. 3 mine were among the 10 leading producers in the United States.

TABLE 3.—Coal (bituminous) production in 1961, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated			Production (short tons)			Value
	Underground	Strip	Auger	Underground	Strip	Total	
Adams	----------	1	----------	----------	35,866	35,866	$252,368
Brown	----------	1	----------	----------	1,730	1,730	7,491
Bureau	----------	1	----------	----------	304,205	304,205	(1)
Christian	1	----------	----------	4,587,309	----------	4,587,309	(1)
Clinton	1	----------	----------	10,875	----------	10,875	57,259
Douglas	1	----------	----------	571,181	----------	571,181	(1)
Franklin	3	----------	----------	3,778,864	----------	3,778,864	(1)
Fulton	2	13	----------	9,917	4,955,330	4,965,247	20,339,595
Gallatin	2	1	----------	62,402	74,149	136,551	428,617
Greene	----------	1	----------	----------	6,424	6,424	34,717
Grundy	----------	1	----------	----------	6,917	6,917	(1)
Henry	1	----------	----------	96,013	----------	96,013	(1)
Jackson	2	2	----------	415,723	676,702	1,092,425	(1)
Jefferson	1	1	----------	2,884,373	15,433	2,899,806	(1)
Kankakee	----------	1	----------	----------	347,940	347,940	(1)
Knox	----------	3	----------	----------	2,049,436	2,049,436	(1)
Logan	1	----------	----------	25,896	----------	25,896	116,532
Macoupin	1	----------	----------	312,192	----------	312,192	1,290,286
Madison	2	----------	----------	623,235	----------	623,235	2,632,961
Marion	1	----------	----------	24,108	----------	24,108	91,590
Menard	1	----------	----------	10,593	----------	10,593	64,138
Mercer	1	1	----------	17,946	3,026	20,972	108,730
Montgomery	1	----------	----------	2,055,334	----------	2,055,334	(1)
Peoria	3	6	----------	21,113	845,472	866,585	4,356,605
Perry	----------	2	----------	----------	2,618,173	2,618,173	(1)
Pope	----------	----------	1	----------	----------	[2] 42,511	85,023
Randolph	1	2	----------	760,788	945,687	1,706,475	(1)
St. Clair	3	3	----------	893,276	3,491,543	4,384,819	15,746,597
Saline	2	7	----------	1,223,351	1,832,233	3,055,584	11,964,354
Sangamon	2	----------	----------	85,752	----------	85,752	385,884
Schuyler	1	1	----------	3,789	626,004	629,793	(1)
Stark	----------	1	----------	----------	377,512	377,512	(1)
Vermilion	3	4	----------	42,864	1,081,798	1,124,662	(1)
Wabash	----------	1	----------	----------	1,894	1,894	7,825
Washington	2	----------	----------	26,663	----------	26,663	(1)
Will	----------	1	----------	----------	389,144	389,144	(1)
Williamson	13	6	----------	3,873,991	2,098,886	5,972,877	23,530,606
Total	52	61	1	22,417,548	22,785,504	45,245,563	177,069,740

[1] Figure withheld to avoid disclosing individual company confidential data; included in total.
[2] Auger-mining production.

Except for 42,500 tons recovered by auger-mining methods, production was nearly equally divided between strip and underground mines. Output from underground mines decreased 4 percent from 1960, but production from strip mines increased less than 1 percent.

Approximately 90 percent of the coal was cleaned at 55 plants. Almost the entire underground production was cut by machines and mechanically loaded. Loading equipment included 101 mobile loaders, 40 continuous miners, and 9 duckbills or self-loading conveyors. Stripping and loading equipment used at strip mines included 155 power shovels and draglines (including wheel excavators) and 126 bulldozers. Over 83 percent of the coal was shipped to consumers by rail; 10 percent, by truck; and 6 percent, by waterways. Very little coal was consumed at the mines.

Late in 1961, Delta Coal Corp. began developing a new strip mine near Vermont in Fulton County. Planned capacity of the mine was 800,000 tons yearly.

Coke.—Approximately 1,841,000 short tons of coke valued at $35.4 million was produced at five plants, compared with 1,971,000 tons valued at $37.1 million in 1960. Nearly 1,807,000 tons was captive for company blast furnaces. About 128,000 tons of coke breeze valued at $840,000 was recovered at coke plants; 106,000 tons was used by producers in agglomerating plants. Other products of coke-oven plants included coke-oven gas, ammonia, tar, crude light oil, and light-oil derivatives. Granite City Steel Co. completed construction of a battery of 61 coke ovens at its integrated steel plant at Granite City. This new battery was designed to produce 1,000 tons of coke daily in support of the company's expanded blast-furnace capacity. The coke ovens of Youngstown Sheet & Tube Co. were inactive the entire year.

Peat.—Output of peat increased 7 percent in quantity and 6 percent in value. Bogs were operated by three companies, in Cook, Kane, and Lake Counties. The peat was sold only in bulk form and entirely for soil conditioning.

Petroleum, Natural Gas, and Natural Gas Liquids.—Crude petroleum represented 42 percent of the total value of mineral production; output increased 3 percent in quantity and 4 percent in value over that in 1960, and came mostly from wells in the southeastern part of the State. Hydraulic-fracturing and waterflooding methods continued to provide about one-half the production. According to the Illinois State Geological Survey, 1,832 wells were completed in 1961; 803 were producing oil wells; 27 were gas wells; 534 were dry holes in pools, and 468 were unsuccessful wildcats. Drilling decreased 1 percent from that in 1960 to 3,982,726 feet, of which 48 percent was in producing wells. Estimated proved crude-oil reserves at the beginning of 1961 were 556 million barrels, according to the American Petroleum Institute.

Marketed natural gas decreased 15 percent in quantity and 12 percent in value. Output of natural gasoline increased 3 percent in quantity but remained about the same in total value as in 1960. Production of liquified petroleum gases decreased 5 percent in quantity and

TABLE 4.—Crude petroleum production, by fields[1]

(Thousand barrels)

Field	1957	1958	1959	1960	1961[2]
Albion	1,313	1,377	1,113	888	863
Benton	807	606	529	467	442
Boyd	952	668	485	382	----------
Bridgeport	4,174	5,280	6,264	7,174	7,330
Centralia	2,076	3,480	2,160	1,420	995
Clay City	8,187	7,972	7,269	7,470	6,683
Dale	2,441	2,485	1,979	2,506	3,136
East Inman	1,415	1,537	1,126	746	495
Johnsonville	1,010	992	1,698	1,438	1,433
Louden	11,691	13,158	12,586	12,628	13,356
New Harmony	3,462	4,430	4,758	5,252	5,246
Phillipstown	547	691	606	653	622
Robinson	2,752	2,755	3,197	3,624	4,033
Roland	2,449	2,155	1,860	1,545	1,304
Sailor Springs	1,552	1,531	1,378	1,382	1,281
Salem	5,644	6,475	6,926	8,482	9,659
Other fields[3]	26,611	24,683	22,793	21,284	22,509
Total	77,083	80,275	76,727	77,341	79,387

[1] Based on Oil and Gas Journal data adjusted to Bureau of Mines total.
[2] Preliminary figures.
[3] Bureau of Mines figures.

17 percent in total value. Estimated proved recoverable reserves of natural gas liquids, according to the American Gas Association, were 10,053,000 barrels on January 1 and 9,500,000 barrels at yearend.

NONMETALS

Cement.—Four companies produced portland and masonry cements at plants in La Salle and Lee Counties. Shipments of portland cement were 2 percent less than in 1960, and were the lowest recorded since 1957. The value of portland cement output declined 3 percent, chiefly because of decreased demand for highway construction and building purposes. Sales of masonry cement declined 7 percent in quantity, but increased 1 percent in value, compared with those in 1960. Sales distribution of portland cement by type of customer in percentage of total shipments and as related to 1960 statistics was as follows:

	Percent	*Percent change*
Building material dealers	7	—14
Concrete product manufacturers	12	—10
Ready-mixed concrete plants	65	+8
Highway contractors	15	—22
Miscellaneous	<1	+58

Value per barrel of portland cement averaged $3.29, compared with $3.34 in 1960.

TABLE 5.—Finished portland cement produced and shipped

(Thousand barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills	
			Quantity	Value
1952–56 (average)	4	8,772	8,751	$22,693
1957	4	8,794	8,097	24,560
1958	4	9,433	9,205	29,308
1959	4	9,559	9,486	30,158
1960	4	9,270	8,770	29,321
1961	4	8,757	8,595	28,301

A total of 2.4 million tons of limestone was quarried for use in manufacturing portland cement; other raw materials consumed included 149,000 tons of clay and shale, 47,000 tons of gypsum, and lesser quantities of anhydrite, sand, slag, iron ore, grinding aids, air-entraining compounds, and other materials. About 80 percent of the portland-cement and 52 percent of the masonry-cement produced was distributed within the State; the remainder was shipped mostly to Indiana, Iowa, Minnesota, and Wisconsin. About 4.6 million barrels in bulk and 307,000 barrels in bags was shipped by truck. The railroads transported approximately 3.2 million barrels in bulk and 497,000 barrels in bags. Approximately 233 million kwhr of electric energy was used.

Nearly 97 percent of the portland-cement production consisted of general use types; the remainder was high early strength and special use types. Annual finished portland-cement capacity increased to 10.7

million barrels per year, chiefly because a new 400-foot kiln was added to the Medusa Portland Cement Co. Dixon plant.

Near Joppa, Missouri Portland Cement Co. began constructing a new cement plant that was expected to be completed in 1963 and to have an annual capacity of 3 million barrels.

Clays.—Total production of fire clay and miscellaneous clay and shale declined 16 percent in quantity and 24 percent in value. Fireclay output decreased 27 percent, and production of miscellaneous clay and shale declined 14 percent. Chief reason for the marked decrease was a 28-percent decline in output for heavy clay products, which was not offset by a 29-percent gain in production for lightweight aggregate. Output for refractory use and manufacturing cement decreased significantly.

Clay sold was 138,548 short tons valued at $1,200,000. Clay used was 1,843,719 tons valued at $2,966,000. Production was reported from operations in 24 counties. Fire clay came from 7 counties and 11 companies.

TABLE 6.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	387	$1,062	1,866	$2,920	2,253	$3,982
1957	438	2,345	1,479	2,810	1,917	5,155
1958	725	2,733	1,610	3,177	2,335	5,910
1959	322	2,158	1,908	2,792	2,229	4,950
1960	359	2,378	1,997	3,101	2,357	5,479
1961	263	1,764	1,719	2,402	1,982	4,166

Fluorspar.—Illinois, furnishing 57 percent of total domestic shipments, led the 7 fluorspar-producing States. The State output declined 13 percent in tonnage and 14 percent in value over that in 1960, chiefly because of a cutback in aluminum production, lack of demand by the steel industry, and imports. Nearly 75 percent of the shipments were classified as acid grade; 21 percent, as ceramic; and 4 percent, as metallurgical.

Mills in Illinois processed 371,000 tons of crude ore, from which 116,000 tons of finished fluorspar was produced. All finished fluorspar was produced in Hardin County; some crude ore was mined in Pope County. Leading producers were Aluminum Company of America, Minerva Oil Co., and Ozark-Mahoning Co. These companies also produced lead and (or) zinc concentrates as byproducts of fluorspar mining.

The No. 1 mine and mill of Minerva Oil Co. were closed from April 24 to September 8 because of a labor strike. The company Crystal mill was closed temporarily late in the year. The new shaft at the Minerva Fairbairn property was virtually completed by yearend. Ozark-Mahoning Co. curtailed operations part of the year chiefly because of lack of demand for finished fluorspar. Mackey-Humm

Mining Co. sold its property; its mill was operated only a short time in 1961.

Stocks of finished fluorspar at the beginning of the year were 8,972 short tons, and increased to 13,271 short tons at yearend.

Gem Stones.—Gem materials consisted mainly of glacial agates, fluorite, and other mineral specimens. These materials were obtained by individuals principally for private collections.

Lime.—Illinois ranked ninth in quantity and sixth in total value of lime produced in 1961. The lime came entirely from plants operated by three companies in Cook and Adams Counties. Total shipments of quicklime and hydrated lime increased 10 percent in quantity and 9 percent in value. Over 61 percent of the output was for refractory use; 32 percent, for chemical and other industrial uses; and about 7 percent, for building purposes. Production of lime for all principal uses increased. A small tonnage was sold for agricultural use. About a third of the total tonnage was shipped to consumers within the State.

Perlite.—Crude perlite shipped from California, Colorado, and New Mexico was processed at plants in Champaign, Cook, De Kalb, Lake, and Will Counties. Processed material decreased 2 percent in quantity and 4 percent in value. Approximately one-half the total output was used as lightweight aggregate in plaster and concrete; the other half was used for loose-fill insulation, filler, filter use, soil conditioning, and other purposes.

Sand and Gravel.—Illinois ranked fifth in quantity and fourth in value of sand and gravel produced in 1961. Total production was 31.4 million short tons valued at $35.1 million, reflecting a 5-percent decrease in quantity and a 3-percent decline in value. Principal reasons for the decreased output were an 8-percent decline in material for building use and a 6-percent reduction in output of paving material. Requirements for railroad ballast were reduced about one-third. There was an appreciable increase in demand for industrial sands.

Of the total output of sand and gravel, 61 percent was used for paving, and 24 percent was utilized for building; 82 percent was transported by truck; 17 percent, by rail; and less than 1 percent, by water.

Output of sand and gravel was reported from 76 counties. Counties that produced more than 1 million tons each were Grundy, Kane, Lake, La Salle, McHenry, Peoria, Tazewell, Will, and Winnebago. Major producers included Material Service Corp., Consumers Co., McGrath Sand & Gravel Co., Inc., Ottawa Silica Co., Chicago Gravel Co., Elmhurst-Chicago Stone Co., McHenry Sand & Gravel Co., Inc., Illinois-Wisconsin Sand & Gravel Co., C. A. Powley Co., Weldron Silica Co., Carlson Bros. Sand & Gravel Co., and Manley Sand Division of Martin-Marietta Corp.

Stone.—Total stone production decreased 13 percent in quantity and 14 percent in value, chiefly because of a 5-million ton drop in output of crushed limestone for concrete aggregate and roadstone. However, the State ranked third in national production, exceeded only by Pennsylvania and Texas.

TABLE 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	1,344	$3,306	1,338	$3,172
Molding	528	1,658	626	2,300
Building	4,769	4,292	4,367	4,279
Paving	6,806	6,407	6,910	6,489
Railroad ballast	(1)	(1)	22	17
Engine	57	105	(1)	(1)
Fill	674	392	862	528
Ground	181	1,851	216	1,982
Undistributed [2]	555	2,084	523	1,835
Total	14,914	20,095	[3] 14,866	[3] 20,600
Gravel:				
Building	3,322	3,349	3,121	3,007
Paving	11,686	10,886	11,361	10,169
Railroad ballast	164	120	111	71
Fill	805	447	658	396
Other	312	253	398	335
Total	16,289	15,055	[3] 15,650	13,978
Total sand and gravel	31,203	35,150	30,516	34,578
Government-and-contractor operations:				
Sand: Paving	388	193	114	56
Gravel:				
Building	27	11	7	4
Paving	1,517	901	707	456
Fill	3	1	9	4
Total	1,547	[3] 912	723	464
Total sand and gravel	1,935	1,105	837	520
All operations:				
Sand	15,302	20,288	14,980	20,656
Gravel	17,836	15,967	16,373	14,442
Grand total	33,138	36,255	31,353	35,098

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.
[2] Includes railroad ballast, and blast sand (1960), grinding and polishing, fire or furnace, filter, hydrafrac, and other industrial sands (1960–61); engine sand (1961).
[3] Data do not add to totals shown because of rounding.

Stone production was entirely limestone, except for a small quantity of sandstone produced in Alexander County for refractory purposes. Limestone was produced in 61 counties. Major producing counties, each with production of over 1 million tons, were Cook, Du Page, Kankakee, La Salle, Livingston, St. Clair, and Will. These counties furnished 58 percent of the limestone production. Output for concrete aggregate and roadstone accounted for 75 percent of the total; agricultural lime represented 9 percent. Limestone for rough building stone, veneer, and flagging came from Adams, Cook, Kane, McHenry, Pike, St. Clair, and Union Counties.

Major limestone producers were Allied Chemical Corp., Columbia Quarry Co., Consumers Co., Dolese & Shepard Co., East St. Louis Stone Co., Elmhurst-Chicago Stone Co., Lehigh Stone Co., Marquette Cement Manufacturing Co., Material Service Corp., and Rein, Schultz, & Dahl, Inc.

TABLE 8.—Limestone sold or used by producers, by uses

Use	1960 Quantity	1960 Value (thousands)	1961 Quantity	1961 Value (thousands)
Dimension:				
Rough construction and flagging [1] thousand short tons..	4	$32	20	$133
House-stone veneer............thousand cubic feet..	30	103	29	100
Total........approximate thousand short tons [2]..	6	135	23	233
Crushed and broken:				
Riprap........................thousand short tons..	495	686	890	909
Concrete aggregate and roadstone.............do....	32,420	43,640	27,237	36,169
Railroad ballast..............................do....	261	300	269	268
Agriculture...................................do....	3,329	4,744	3,414	5,030
Asphalt.......................................do....	307	870	163	449
Cement..do....	2,644	1,829	2,441	1,711
Other [3].....................................do....	2,258	3,383	1,923	3,165
Total...do....	41,714	55,452	36,337	47,701
Grand total...................................do....	41,720	55,587	36,360	47,934

[1] Rough construction and flagging combined to avoid disclosing individual company confidential data.
[2] Average weight of 170 pounds per cubic foot used to convert cubic feet to short tons.
[3] Includes limestone for chemical uses, filler, lime, metallurgical, and other purposes combined to avoid disclosing individual company confidential data.

Slightly less than 7 percent of the production was shipped by rail, 92 percent by truck, and the remainder by water.

Sulfur.—The Pure Oil Co. at its Lemont refinery in Cook County and the Anlin Company of Illinois at its plant at Hartford in Madison County recovered 15 percent more elemental sulfur as a byproduct.

Tripoli (Amorphous Silica).—The Ozark Minerals Co. and the Tamms Industries Co. mined and processed tripoli or amorphous silica in northern Alexander County. Tonnage of ore increased less than 1 percent. Sales for use as abrasives, filler, and other purposes declined 2 percent in quantity, but increased 7 percent in value.

Vermiculite.—Crude vermiculite shipped from Montana, South Carolina, and South Africa was exfoliated by Zonolite Co., Mica Pellets, Inc., International Vermiculite Co., and Johns-Manville Perlite Corp. The processed material was used for insulation, concrete and plaster aggregate, and various other industrial purposes. Processed material sold or used increased 37 percent in volume and 44 percent in value.

METALS

Lead and Zinc.—Lead production increased 14 percent in quantity, chiefly because lead recovered as a byproduct of fluorspar mining in southern Illinois increased. Total value, however, increased less than 1 percent because market prices for lead were lower. Zinc output decreased 9 percent in quantity and 19 percent in value because the market was depressed.

Producers of lead and zinc in northern Illinois (Jo Daviess County) were Eagle-Picher Co. and Tri-State Zinc, Inc. Each of these companies operated its mines and mills throughout the year. Leading producers in southern Illinois (Hardin and Pope Counties) were Aluminum Company of America, Minerva Oil Co., and Ozark-Mahoning Co.

Average weighted yearly prices used to calculate total values of lead and zinc production in 1961 were 10.3 cents per pound for lead and 11.5 cents per pound for zinc; corresponding prices in 1960 were 11.7 cents for lead and 12.9 cents for zinc.

TABLE 9.—Mine production of silver, lead, and zinc, in terms of recoverable metals

Years	Mines producing	Materials sold or treated [1] (short tons)	Silver		Lead		Zinc		Total value
			Troy ounces	Value	Short tons	Value	Short tons	Value	
1952–56 (average)	20	785,177	2,387	$2,160	3,852	$1,140,747	18,708	$4,927,182	$6,070,089
1957	23	853,661	--------	--------	2,970	849,420	22,185	5,146,920	5,996,340
1958	19	1,003,020	--------	--------	1,610	376,740	24,940	5,087,760	5,464,500
1959	22	930,265	--------	--------	2,570	591,100	26,815	6,167,450	6,758,550
1960	22	1,015,581	--------	--------	3,000	702,000	29,550	7,623,900	8,325,900
1961	20	965,541	--------	--------	3,430	706,580	26,795	6,162,850	6,869,430

[1] Data include fluorspar ore from which lead and (or) zinc were recovered as follows: 1952, 384,203 tons; 1953, 353,570 tons; 1954, 202,478 tons; 1955, 309,311 tons; 1956, 336, 635 tons; 1957, 360,406 tons; 1958, 401,562 tons; 1959, 297,252 tons; 1960 (revised), 380,395 tons; and 1961, 368,283 tons.

TABLE 10.—Mine production of silver, lead, and zinc, by months in terms of recoverable metals

(Short tons)

Month	Northern Illinois		Southern Illinois		Total Illinois	
	Lead	Zinc	Lead	Zinc	Lead	Zinc
January	95	1,710	171	925	266	2,635
February	95	1,610	230	780	325	2,390
March	150	1,705	254	905	404	2,610
April	195	1,500	196	755	391	2,255
May	105	1,480	156	485	261	1,965
June	80	1,580	236	540	316	2,120
July	70	1,240	206	470	276	1,710
August	90	1,650	186	565	276	2,215
September	100	1,450	175	670	275	2,120
October	100	1,520	135	757	235	2,277
November	65	1,500	140	778	205	2,278
December	60	1,480	140	740	200	2,220
Total	1,205	18,425	2,225	8,370	3,430	26,795

Pig Iron and Steel.—Nearly 4.8 million short tons of pig iron, 9 percent less than in 1960, was shipped from Illinois blast furnaces or consumed by producing companies. Estimated value of output was over $288 million. Six companies operated blast furnaces in Chicago and Granite City. The 22 blast furnaces operated an average 159 days in 1961; 4 operated the entire year, 7 were idle throughout the year, and 11 were out of blast part of the year. At its Granite City works, Granite City Steel Co. completed construction of a new blast furnace, which had a daily capacity of 1,800 tons of pig iron and replaced the company's B furnace dismantled in 1960.

Over 6.6 million short tons of domestic iron and manganiferous ores (excluding agglomerates) was consumed in Illinois blast and steel furnaces and agglomerating plants. In addition, 1.1 million short tons of iron-ore pellets, produced at or near mine sites outside the State, and 450,000 short tons of foreign ore was consumed in Illinois furnaces. Nearly 3 million tons of sinter was produced at consuming furnaces. About 4.2 million tons of agglomerates (sinter and pellets), 3.5 million tons of coke, and 1.9 million tons of limestone and dolomite were consumed. Data for nonintegrated steel plants are not included.

According to the American Iron & Steel Institute, steel production in Illinois was 8,395,245 short tons, an increase of about 2 percent over that in 1960. Steel furnaces were operated by 13 companies.

Other Metals.—Lindsay Chemical Division of American Potash & Chemical Corp. manufactured refined thorium compounds at West Chicago from monazite concentrate originating outside the State. It also produced rare-earth compounds.

Some ores mined in Illinois contained small but valuable quantities of certain metals, such as cadmium, gallium, and germanium, which were recovered in later processing stages at plants in Illinois or other States.

REVIEW BY COUNTIES

Mineral output, excluding liquid fuels and natural gas, was reported from 97 of the 102 counties. La Salle County, furnishing 6 percent of the total value of minerals produced, led the State. Other major mineral-producing counties, each with value of mineral output exceeding $10 million, were Christian, Cook, Franklin, Fulton, Jefferson, St. Clair, Saline, and Williamson. In 35 counties total value of mineral production increased; in 62 counties it decreased; and in 1 county no change was reported.

Some counties are excluded from the county-review section. The breakdown of details by county on liquid fuels and natural gas operations was not available. However, all producing counties as well as the minerals produced are listed in Table 11. Only those coal producers whose output was 1,000 short tons or more are included, unless otherwise stated.

Adams.—Limestone for a large variety of uses was produced at four open-pit and three underground mines. It was quarried by Missouri Gravel Co. and Western Illinois Stone Co. (Nos. 7, 8, and 9 quarries), subsidiaries of Moline Consumers Co., and mined underground by Black White Limestone Co., Marblehead Lime Co., and Menke Stone & Lime Co. Marblehead Lime Co. and Menke Stone & Lime Co. also produced quicklime and hydrated lime in plants near Quincy.

Paving sand was produced by Blick Construction Co. Quincy Sand Co. dredged sand for construction, fill, and other purposes near Quincy. Triple S Mines, Inc., produced about 36,000 tons of coal from a strip mine near Augusta. This output was cleaned by jigging and was treated with oil. Sales, all for local consumption, declined 5 percent from 1960.

Alexander.—Ozark Minerals Co. and Tamms Industries Co. near Elco and Tamms, respectively, mined amorphous silica underground. They sized, ground, and cleaned the ore at company-operated mills.

TABLE 11.—Value of mineral production in Illinois, by counties [1]

County	1960	1961	Minerals produced in 1961 in order of value
Adams	$2,310,787	$1,871,602	Stone, lime, coal, sand and gravel.
Alexander	222,528	221,034	Tripoli, sand and gravel, stone.
Bond	214,506	214,104	Sand and gravel, stone, clays.
Boone	163,619	(2)	Sand and gravel, stone.
Brown	189,944	93,750	Stone, clays, coal.
Bureau	(2)	2,100,483	Coal, sand and gravel, clays.
Calhoun	13,290	461,347	Stone, sand and gravel.
Carroll	168,339	218,203	Do.
Cass	7,658	1,150	Sand and gravel.
Champaign	269,447	303,067	Do.
Christian	(2)	(2)	Coal, stone.
Clark	600,678	626,803	Stone, sand and gravel.
Clay	(2)	184,200	Stone.
Clinton	475,021	331,641	Stone, coal, sand and gravel.
Coles	789,728	(2)	Stone, sand and gravel.
Cook	30,060,552	26,598,892	Stone, lime, sand and gravel, clays, peat.
Crawford	135,556	134,456	Sand and gravel.
Cumberland	(2)	122,403	Sand and gravel, stone.
De Kalb	445,471	441,194	Stone, sand and gravel.
De Witt	80,375	(2)	Sand and gravel.
Douglas	(2)	(2)	Coal.
Du Page	(2)	(2)	Stone, sand and gravel.
Edwards	(2)	60,810	Sand and gravel, clays.
Effingham	(2)	22,800	Stone.
Fayette	88,669	86,423	Sand and gravel, clays.
Ford	(2)	(2)	Sand and gravel.
Franklin	(2)	(2)	Coal.
Fulton	22,665,384	20,738,818	Coal, sand and gravel.
Gallatin	338,119	565,797	Do.
Greene	494,378	452,725	Stone, clays, coal, sand and gravel.
Grundy	(2)	(2)	Sand and gravel, clays, coal.
Hancock	326,931	286,564	Stone, sand and gravel.
Hardin	10,197,518	8,816,092	Fluorspar, zinc, stone, lead.
Henderson	328,982	272,382	Stone.
Henry	601,960	(2)	Coal, stone, sand and gravel.
Iroquois	1,434	3,609	Sand and gravel.
Jackson	5,345,076	(2)	Coal, stone, sand and gravel.
Jefferson	(2)	(2)	Coal, stone.
Jersey	(2)	201,960	Stone, sand and gravel.
Jo Daviess	(2)	(2)	Zinc, lead, stone, sand and gravel.
Johnson	1,322,607	1,098,089	Stone, sand and gravel.
Kane	2,774,810	2,508,572	Sand and gravel, stone, peat.
Kankakee	4,159,499	3,712,536	Coal, stone, clays, sand and gravel.
Kendall	376,707	(2)	Stone, sand and gravel.
Knox	(2)	(2)	Coal, stone, sand and gravel.
Lake	963,345	1,205,651	Sand and gravel, clays, peat.
La Salle	35,115,631	33,711,134	Cement, sand and gravel, stone, clays.
Lawrence	237,721	293,320	Sand and gravel.
Lee	(2)	(2)	Cement, stone, sand and gravel, clays.
Livingston	2,257,626	1,927,472	Stone, clays, sand and gravel.
Logan	618,069	594,564	Stone, sand and gravel, coal.
Macon	(2)	(2)	Sand and gravel.
Macoupin	1,513,242	1,290,286	Coal.
Madison	4,113,535	4,151,915	Coal, stone, sand and gravel.
Marion	------------	91,590	Coal.
Marshall	(2)	304,891	Sand and gravel, clays.
Mason	11,634	21,484	Sand and gravel.
Massac	(2)	(2)	Stone, sand and gravel.
McDonough	414,128	295,408	Stone, clays.
McHenry	3,164,138	2,775,330	Sand and gravel, stone.
McLean	398,778	579,216	Sand and gravel.
Menard	545,105	675,587	Stone, coal, clays.
Mercer	363,582	313,152	Do.
Monroe	(2)	(2)	Stone.
Montgomery	(2)	(2)	Coal, stone.
Morgan	772	------------	
Moultrie	------------	13,593	Sand and gravel.
Ogle	1,575,180	1,546,477	Sand and gravel, stone.
Peoria	4,773,532	6,557,595	Coal, sand and gravel, stone.
Perry	10,272,554	(2)	Coal.
Piatt	------------	(2)	Sand and gravel.
Pike	406,971	457,234	Stone, sand and gravel.
Pope	9,754	88,393	Coal, sand and gravel.
Pulaski	630,212	271,956	Stone, sand and gravel, clays.
Putnam	------------	8,793	Sand and gravel.
Randolph	7,439,217	6,960,359	Coal, stone, sand and gravel.
Rock Island	1,634,097	1,502,447	Stone, sand and gravel, clays.
St. Clair	21,409,993	19,896,385	Coal, stone, sand and gravel, clays.
Saline	11,999,588	11,964,354	Coal.

See footnotes at end of table.

TABLE 11.—Value of mineral production in Illinois, by counties [1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Sangamon	$1,000,539	$910,380	Sand and gravel, coal, clays.
Schuyler	(2)	(2)	Coal, sand and gravel, stone.
Scott	273,678	(2)	Stone, clays, sand and gravel.
Shelby	226,831	181,509	Stone, sand and gravel.
Stark	738,216	(2)	Coal, sand and gravel.
Stephenson	427,321	260,740	Stone, sand and gravel.
Tazewell	1,603,193	(2)	Sand and gravel, clays.
Union	1,579,848	753,695	Stone, sand and gravel.
Vermilion	6,639,156	6,034,299	Coal, stone, clays, sand and gravel.
Wabash	243,580	198,204	Sand and gravel, coal.
Warren	(2)	(2)	Stone.
Washington	395,157	(2)	Stone, coal.
Wayne	13,965	(2)	Sand and gravel.
White	229,154	190,764	Do.
Whiteside	301,627	280,025	Stone, sand and gravel.
Will	9,475,255	7,659,732	Stone, sand and gravel, coal.
Williamson	24,975,529	23,530,606	Coal.
Winnebago	2,224,120	2,318,707	Sand and gravel, stone.
Woodford	(2)	(2)	Sand and gravel.
Undistributed	[3] 340,978,974	359,030,623	
Total	[3] 586,364,000	571,605,000	

[1] Excludes gem stones, petroleum, natural gas, natural gas liquids, and some stone and sand and gravel for which data by counties are not available; included with "Undistributed." The following counties did not report production: Edgar, Hamilton, Jasper, and Richland.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Most of the processed material was bagged and shipped to consumers by rail. There was a small increase in quantity over the 1960 production, but value declined appreciably.

Western Fire Brick Co. mined sandstone near Elco for use principally as a refractory. The crude material was shipped to the company plant at East St. Louis for processing.

H. H. Halliday Sand Co., at a dredge on the Ohio River, produced sand and gravel for building, paving, and other construction purposes. The county highway department produced paving gravel.

Bond.—Richards Brick Co. produced nearly 50,000 tons of clay near New Douglas for manufacturing building brick at its plant near Edwardsville, Madison County.

Sand and gravel was produced at two stationary plants near Greenville. Greenville Gravel Co. used its output in a company-owned ready-mixed concrete plant. Robert Pruitt Sand & Gravel Co., leasing from George Mayhew of Greenville, produced material for building uses and railroad ballast. Cyril Munie, operating both stationary and portable plants near Pocahontas, produced material for building and road construction and fill; some material was sold to the county and State for paving use. Bond Stone Co. crushed limestone from a quarry near Sorento for roadstone.

Boone.—Belvidere Blacktop Co., Inc., formerly Davis Sand & Gravel Co., produced sand and gravel for construction purposes in a portable plant near Belvidere. Several other companies produced sand and gravel mainly for road construction.

Belvidere Lime Quarry produced 21,000 tons of limestone in a portable plant near Belvidere for use as roadstone and fertilizer.

Brown.—Brown County Stone Co. and Missouri Gravel Co. crushed limestone for use as roadstone and aggregate; both companies operated near Mount Sterling. Brown County Stone Co. purchased the T. F. Hollembeak & Sons plant that produced sand and gravel and crushed limestone in 1960, but did not produce in 1961. Frederic Brick & Tile Co. produced clay near Mount Sterling for manufacturing draintile. Big Four Mines produced 1,700 tons of coal from a strip mine near Mount Sterling. Output was entirely for local consumption.

Bureau.—Near Mineral, Midland Electric Coal Corp. produced over 304,000 tons of coal from its strip mine, the only active coal mine in the county. It cleaned the entire output at the company plant, which also processed coal from the Midland Collieries, Inc., Victoria No. 5 mine in Knox County. Shipments to consumers were chiefly by rail.

About 823,000 tons of sand and gravel was produced. More than 70 percent was used for paving and fill; the remainder was used for construction. Floyd Clapp and Walnut Sand & Gravel Co. operated near Walnut. Portable plants were operated by Hansen Bros., Swanson Construction Co., and Merle Whipple near Manlius, Princeton, and Buda, respectively. Stationary plants were operated by Western Sand & Gravel Co., near Spring Valley; Wyanet Sand & Gravel, near Wyanet; and Yuccus Gravel Co., near Seatonville. The county and State highway departments produced and (or) contracted for paving sand and gravel.

Near Sheffield, Sheffield Shale Products Co. produced clay for manufacturing building brick and other heavy clay products.

The New Jersey Zinc Co. operated a zinc smelter at Depue but curtailed production part of the year.

Calhoun.—West Lake Quarry Co. at a portable plant near Golden Eagle produced 560,000 tons of limestone for riprap and roadstone for use in major highway construction near Golden Eagle. The Schlieper Bros. plant near Belleview, the only stationary plant in the county, produced over 15,000 tons of road and agricultural stone. Calhoun Quarry Co. and Magnesium Lime Co. also produced roadstone and agricultural limestone. Carl Sievers and West Point Sand Plant produced sand and gravel for building purposes.

Champaign.—The Ryolex Corp. expanded crude perlite mined in California at its Champaign plant for use as a plaster additive. Sand and gravel for use in building construction, paving, and fill was produced at both portable and stationary plants near Champaign, Mahomet, Rantoul, and Ludlow.

Christian.—Coal was produced near Pawnee by Peabody Coal Co. from its No. 10 underground mine, the second largest producing bituminous coal mine in the United States in 1961. Output was 4.6 million tons, an 11-percent increase over that in 1960. Part of the output was cleaned by jigging. Shipments were mostly by rail.

Tri-County Stone Co., crushed limestone for concrete aggregate, roadstone, and agricultural limestone at its stationary plant near Nokomis.

Clinton.—Citizens Coal Co. produced nearly 11,000 tons of coal before abandoning its underground mine near Breese in April. The entire output of coal was consumed locally. No coal was produced in 1961 from the part of the Marion County Coal Mining Corp. underground mine in Clinton County.

Buehne Quarry Co. and Alphonse Huelsmann Quarry, Inc., crushed limestone for concrete aggregate and roadstone. The county highway department produced about 7,000 tons of gravel for building construction.

Cook.—The value of mineral production declined 12 percent to about $27 million. Limestone—about 11 million short tons—led in quantity and value. All production came from stationary plants. Producers were as follows: Consumers Co., Division of Vulcan Materials Co., Bellwood, Lemont, and McCook; Dolese & Shepard Co., Hodgkins; Elroy & Son, Lemont; H. Turner & Son, Lemont; R. P. Donohoe Co., Inc., Lemont; and Material Service Corp., Division of General Dynamics Corp., Federal, Riverside, Stearns, and Thornton. Consumers Co. purchased the Arcole Mid-West Corp. plant.

Processed limestone was marketed as concrete aggregate, roadstone, asphalt filler, metallurgical flux, refractories, railroad ballast, agricultural limestone, flagging, and riprap.

Marblehead Lime Co. produced quicklime and hydrated lime at its Thornton and South Chicago plants, and Standard Lime & Cement Corp. produced refractory lime at its La Grange plant.

More than 800,000 tons of sand and gravel was produced by one portable plant and six stationary plants at Elgin, Algonquin, Glenview, Arlington Heights, and Worth. The processed material was marketed for building construction, paving, railroad ballast, fill, and other uses. Operators were Chicago Gravel Co., Consumers Co., Doetsch Brothers, Material Service Corp., Road Materials Corp., and Worth Sand & Gravel Co., Inc. The State highway department contracted for paving sand and gravel.

Clay for manufacturing building brick was mined by Brisch Brick Co., Stickney; Carey Brick Co., Chicago; Chicago Brick Co., Dolton; and Illinois Brick Co., Blue Island. Tuthill Building Materials Co. ceased operations at Riverdale.

Near Barrington, Henry Frenzer produced peat, which was sold chiefly for soil conditioning.

Lindsay Chemical Division ofAmerican Potash & Chemical Corp. refined thorium compounds and rare-earth compounds at West Chicago.

Blast and steel furnaces and coke ovens were operated in the Chicago area. Producers of pig iron included Interlake Iron Corp., International Harvester Co., Republic Steel Corp., and United States Steel Corp., which was the only company that did not operate coke ovens. The Youngstown Sheet & Tube Co. blast furnaces and coke ovens were inactive throughout 1961. Steel-producing companies included Acme Steel Co., Borg-Warner Corp., Ceco Steel Corp., Columbia Tool Steel Co., A. Finkl & Sons Co., H. M. Harper Co., International Harvester Co., Republic Steel Corp., and United States Steel Corp.

The Chicago plant of Silbrico Corp. exfoliated crude perlite from New Mexico for use as a plaster additive, insulation, concrete aggregate, and other purposes.

The Zonolite Co. processed vermiculite from Montana, South Carolina, and South Africa at its Chicago plant.

The Pure Oil Co., Lemont, recovered elemental sulfur from its refinery gases by the modified Claus process.

U.S. Mica Co., Inc., produced ground mica at its plant near Forest Park.

De Kalb.—Perlite from Colorado and vermiculite from Montana were processed at the De Kalb plant of Mica Pellets, Inc., and were used as building plaster additive, concrete aggregate, soil conditioner, insulation, and for general industrial purposes.

Four operators produced sand and gravel and two crushed limestone.

Douglas.—Moffat Coal Co. produced 571,000 tons of coal, a 13-percent increase, from an underground mine near Murdock. This output was cleaned by jigging. Three-fifths of the cleaned coal was shipped to consumers by rail; the remainder was consumed locally.

Du Page.—Elmhurst-Chicago Stone Co. at a limestone quarry and stationary plant in Elmhurst produced material for concrete aggregate, roadstone, and agricultural purposes. The company also produced sand and gravel for building and road construction, in three stationary plants at Winfield, Warrenville, and Bartlett. Some sand and gravel was produced by township crews for road use.

Edwards.—Near Albion, Albion Brick Co. produced clay for manufacturing building brick. George Aulvin Sand & Gravel Co. produced sand and gravel for various uses near Albion.

Fayette.—Diller Shale Products Co. produced clay near St. Elmo for manufacturing draintile and other heavy clay products. Sand and gravel was produced by four companies operating stationary plants near Vandalia, Hagarstown, Ramsey, and Mulberry Grove; the products were used for building construction, paving, foundry purposes, and fill. The State highway department contracted for a small quantity for paving.

Franklin.—Coal production declined 8 percent to 3.8 million tons. Output came from 3 underground mines—the Orient No. 5 of Freeman Coal Mining Corp. near Benton and the Nos. 9 and 21 mines operated by Old Ben Coal Corp. near West Frankfort and Sesser, respectively. Three preparation plants, utilizing heavy-medium, tables, jigs and pneumatic processing methods, were operated in the county. However, output from the Orient No. 5 mine was processed mostly at the Orient No. 4 plant in Williamson County. Part of the Old Ben No. 21 production was cleaned at the Old Ben No. 9 plant.

Fulton.—Fulton County ranked second in coal production and led in output from strip mines. The production of nearly 5 million tons was 7 percent less than in 1960. All but about 10,000 tons was furnished from 13 strip mines. Two underground mines were operated part of the year by Pine Bluff Coal Co. and Pschirrer Coal Co., but both were abandoned in 1961. Two strip mines operated by Lingenfelter Coal Co. also were abandoned. Approximately 97 percent of the coal was cleaned at 7 plants. About 67 percent was shipped by rail, 27 percent by barge on the Illinois River, and the remainder mostly by truck. Late in 1961, Delta Coal Corp. began development of a new strip mine near Vermont. The mine, which was planned to have a capacity of 800,000 tons, was expected to begin producing in the summer of 1962.

Two companies produced sand and gravel for building, road construction, and other uses.

Gallatin.—Coal production was about 137,000 tons, a 57-percent increase over that of 1960. Output came from one strip mine and two underground mines. The marked gain was attributed to production from the new Herod Mining Corp. strip mine, which began operating near Herod in April. Approximately nine-tenths of the total county output was shipped by barge on the Ohio River; the remainder was sold locally. None of the coal produced was mechanically cleaned or treated. Less than 1,000 tons of coal was produced from the H. & V. Coal Co. strip mine, which was abandoned early in 1961.

The Gail Denny Sand Co. stationary plant near Harrisburg and the Delta Materials Co. portable plant near Shawneetown produced sand and gravel for paving and fill. The State highway department purchased some of the Delta production.

Greene.—Vitrified clay sewer pipe was manufactured from clay mined by American Vitrified Products Co. at Winchester. Wyatt's Clay Mines, Inc., near Roodhouse, was sold to Eddie Geldner, Fulton, Mo.

Four companies, operating near East Hardin, Hillview, and Kane, produced limestone for use as riprap and roadstone. Lyle B. Moushon produced sand and gravel for the State highway department.

Birch Creek Coal Co. produced about 6,400 tons of coal from a strip mine near Roodhouse. Output decreased 9 percent and was entirely for local consumption. Part of the output was treated with oil.

Grundy.—Illinois Clay Co. produced clay from pits near Coal City and Norris for manufacturing firebrick, block, and other heavy clay products.

Material Service Corp., Division of General Dynamics Corp. produced sand and gravel from its Norris pit for use as paving material.

Peabody Coal Co. produced 6,900 tons of coal from the part of its strip mine in Grundy County near Wilmington. The mine also extended into Kankakee and Will Counties.

Hardin.—Shipments of finished fluorspar were 13 percent less than those made in 1960. Seventy-four percent, a 15-percent decrease, of the total shipments was acid grade; 21 percent, a 62-percent increase was ceramic grade; and 5 percent, a 68-percent decrease was metallurgical grade.

Imports, a lower average market price, a 5-month strike at the Minerva Oil Co. No. 1 mine and mill, the closing of the Ozark-Mahoning Co. plant for about 8 weeks, and a cutback by Aluminum Company of America of its operations at Rosiclare contributed substantially to the reduced production.

Major producing companies were the Aluminum Company of American, Minerva Oil Co., and Ozark-Mahoning Co., Miller-Addick Co. purchased Mackey-Humm Mining Co., a former major producer that had no output in 1961. Aluminum Company of America operated its group of mines and a mill near Rosiclare. Minerva Oil Co. operated its Crystal and No. 1 mines and mills. Some custom ore was processed at both plants. Ozark-Mahoning Co. operated several of its mines in the Cave-in-Rock area and its flotation mill at Rosiclare. Its new heavy-medium plant was operated below capacity.

Other companies operating in the district included Rosiclare Lead & Fluorspar Mining Co., Goose Creek Fluorspar Mining Co., and Hoeb Mining Co. Some fluorspar ore mined in Illinois was processed at plants in Kentucky.

Lead and zinc concentrates, byproducts of fluorspar processing, were produced in the county.

Crushed limestone was produced for roadstone and agricultural purposes.

Henry.—Coal production increased 31 percent and came entirely from an underground mine operated by Shuler Coal Co. near Alpha. Coal was shipped to consumers mostly by rail.

The Collinson Bros. portable plant near Kewanee produced paving gravel, some of which was purchased by county and local governments. Schadt Service Co. produced sand and gravel for building construction, paving, and fill at its stationary plant near Cleveland.

McCarthy Improvement Co. crushed limestone for roadstone and agricultural purposes near Cleveland.

Jackson.—About 1.1 million tons of coal, 17 percent less than in 1960, was produced. Nearly 62 percent of the output came from 2 strip mines; the remainder, from 2 underground mines. Truax-Traer Coal Co. operated the Burning Star No. 1 strip and underground mines near Elkville. The new slope entrance of the underground mine was opened in January. Coal mined by the company was cleaned at the Burning Star No. 2 plant in Perry County. Elk Coal Co. operated an underground mine and preparation plant near Elkville. Farley Bros. Coal Co. produced coal from a strip mine near DeSoto.

Near Ava, Illinois Quarry Co. crushed limestone for roadstone and agricultural use. Lawder Sand Co. produced sand and gravel for building construction, road base, and fill at a stationary plant near Grand Tower.

Jefferson.—Coal production was 2.9 million tons, a 2-percent decline from 1960. Output came from the Orient No. 3 underground mine operated near Waltonville by Freeman Coal Mining Corp., and from a strip mine operated near Belle Rive by Belle Rive Mining Co. The Orient No. 3 mine continued to rank fourth as a producing bituminous coal mine in the Nation. Its entire output was processed using jigs, heavy-medium, and pneumatic methods.

Randall Stone Co. quarried limestone near Mount Vernon for use as roadstone.

Jo Daviess.—Two companies mined lead-zinc ores. Eagle-Picher Co. operated the Graham, Snyder, Spillane, and Feehan properties and the O'Rourke mine. Ore from these operations and ore mined by Eagle-Picher in Wisconsin was concentrated by jigging, tabling, and flotation at the company Graham mill. Tri-State Zinc, Inc., operated its Gray and Amelia mines near Galena and treated ore from both mines at its Gray mill. Hickory Hill Mining Co. and Little Ginte Mining Co. did not operate in 1961.

Dubuque Sand & Gravel Co. produced sand and gravel for building, paving, and fill from its stationary plant at East Dubuque.

Limestone was crushed by Broege Limestone Co., Midland Co., Elmer Wienen & Sons Co., and Willowa Engineering Co. The output was used for concrete aggregate and roadstone, agricultural purposes, and railroad ballast.

Kane.—Thirteen companies produced 2.3 million tons of sand and gravel from stationary and portable plants. Operations were mainly near Aurora, Dundee, East Dundee, Elburn, Elgin, Hampshire, and Wayne. Processed material was used for building construction, paving, fill, and other purposes. The South Elgin pit, Material Service Corp., was depleted and did not produce. However, the company produced material from its new Dundee pit. Considerable quantities of this material were purchased by the State highway department, the county, and the Federal Aviation Agency. The city of Aurora produced 1,200 tons of paving gravel.

Limestone was crushed by Conco-Western Stone Co. near North Aurora and by Fox River Stone Co. near Elgin. It was used for concrete aggregate and roadstone, agricultural purposes, rubble, flagging, and various other purposes. Both companies operated portable plants.

Near Batavia, Batavia Soil Builders produced peat for soil conditioning.

Kankakee.—The only producer of coal was Peabody Coal Co., which operated a strip mine near Wilmington. This mine extended into Grundy and Will Counties. Production from the part of the mine in Kankakee County was about 348,000 tons, 9 percent more than in 1960. The entire output was cleaned by jigging.

Limestone was crushed by Lehigh Stone Co. and Manteno Limestone Co. and used for roadstone, railroad ballast, and agricultural purposes.

Clay produced by Eastern Illinois Clay Co., Kankakee Clay Products Co., and St. Anne Brick & Tile Co. near Kankakee and St. Anne was used for manufacturing building brick, draintile, and structural tile.

Azzarelli Construction Co. and Kankakee Sand Co. produced paving sand. Martin-Marietta Corp. acquired the Essex plant of the National Silica Division, Portage-Manley Sand Co., but did not produce in 1961.

Knox.—Approximately 2 million tons of coal, an 8 percent decrease, was produced. Output came from the Middle Grove No. 2 and Rapatee No. 3 strip mines of Midland Electric Coal Corp. and the Victoria No. 5 strip mine of Midland Collieries, Inc. Output from both Midland Electric mines was cleaned at the Middle Grove plant. Victoria No. 5 production was processed at the Midland Electric Coal Corp. plant in Bureau County. The coal was shipped entirely by rail.

Abingdon Rock Co., Inc., crushed limestone near Abingdon for roadstone and agricultural purposes. The Knox County Gravel Co. operated a portable plant and produced gravel for paving use and fill.

Abingdon Potteries, Inc., operated a feldspar-grinding plant at Abingdon and processed material mined by the company outside the State. The ground feldspar was used in manufacturing pottery.

Lake.—Nine companies produced a total of 1,327,000 tons of sand and gravel which consisted of material processed in stationary and portable plants and of bank-run material. In addition, the county highway department contracted for 65,212 tons. Operations were chiefly near Barrington, Gurnee, Ingleside, Libertyville, Spring Grove, Wadsworth, and Wauconda. The output was used for building, paving, and other purposes.

National Brick Co. mined clay near Deerfield and used it for manufacturing building brick. Perlite obtained from Colorado and New Mexico was expanded at the Lake Zurich plant of Lake Zurich Concrete Products Co. The expanded perlite was used chiefly as lightweight aggregate in plaster.

National Gypsum Co. manufactured gypsum products in Waukegan from crude gypsum mined by the company in Michigan.

Near Lake Villa, Marvin Walker Peat Co. produced peat principally for soil conditioning. At Waukegan, General Motors Corp. produced coke for foundry use.

La Salle.—Portland and masonry cements were produced by Alpha Portland Cement Co. at La Salle and by Lehigh Portland Cement Co. and Marquette Cement Manufacturing Co. at Oglesby. Each company quarried limestone for use in manufacturing cement. Limestone for roadstone and agricultural uses was crushed at plants operated by Beardsley Stone Co., Sheridan; Troy Grove Stone Co., Troy Grove; and Utica Stone Co., Utica. Crushed limestone for all uses totaled more than 2 million tons.

Alpha Portland Cement Co. and Marquette Cement Manufacturing Co. produced shale for their own use in manufacturing cement. Material Service Corp. mined shale near Ottawa and used it in manufacturing lightweight aggregate at a plant on the Illinois River. Several sizes of aggregates were produced, using 2 rotary kilns. The aggregate was shipped by rail and river barge. Conco-Meier Co., near Lowell, and Hydraulic-Press Brick Co., near Utica, mined clay for manufacturing building brick. Illinois Valley Minerals Co. produced fire clay near Ottawa and sold it to steel mills for refractory use. The LaClede Christy operation near Ottawa was inactive throughout 1961.

About 3.5 million tons of sand and gravel, produced by 16 companies, was used for building and road construction, railroad ballast, fill, and special purposes such as glass manufacture, molding, grinding and polishing, filtering, oilfield fracturing, filler, enamel, pottery, and in foundries. Producers of silica sands included The American Silica Sand Co., Inc., The Arrowhead Co., E. C. Bellrose Sand Co., Illinois Silica Sand Co., Ottawa Silica Co., and Wedron Silica Co. Paving sand and gravel was produced under contract for the State highway department.

Matthiessen & Hegeler operated a zinc smelter at La Salle.

Lee.—Medusa Portland Cement Co. using limestone and clay mined nearby, produced portland and masonry cements at its Dixon plant. Overburden stripping by a company-owned dragline began during the period, replacing contract stripping. A new rotary blast-hole drill also was put into operation.

Limestone was crushed by Frank N. Butler Co. near Lee Center; Oregon Stone Quarries and Wastone, Inc., near Dixon; and Stoneridge Limestone Co. at Rochelle. All companies operated portable plants and produced material for roadstone and agricultural use.

Sand and gravel, produced near Steward, Nelson, and Dixon was used for building, paving, railroad ballast, and fill. The State highway department contracted for paving sand and gravel.

Livingston.—About 1 million tons of crushed limestone was produced near Chenoa, McDowell, and Pontiac. This output was used for roadstone, agricultural use, asphalt filler, and other purposes. Producers were Chenoa Stone Co., Livingston Stone Co., Ocoya Stone Co., Pontiac Stone Co., and Wagner Stone Co. All companies operated stationary plants. Chenoa Stone Co. began using ammomnium-nitrate prills for blasting.

Near Streator, Hydraulic-Press Brick Co. mined clay for use in manufacturing building brick, and Streator Clay Pipe Co. produced clay for use in making vitrified sewer pipe. Diller Tile Co., Inc., produced clay near Chatsworth for use in manufacturing building brick. In conjunction with its clay-pit operation, Streator Clay Pipe Co. mined less than 1,000 tons of coal which was used in its manufacturing plant. Paving sand and gravel was produced by two companies.

Logan.—Near Lincoln, the Lincoln Sand & Gravel Co. dredged sand and gravel for building and road construction, engine use, and fill. John Allsopp's Sand & Gravel Co. produced paving gravel for the State highway department. At Lincoln, Rocky Ford Limestone Co. crushed limestone for agricultural use and roadstone. McSpadden Bros. produced nearly 26,000 tons of coal, entirely for local consumption, from an underground mine near Lincoln.

Macoupin.—Little Dog Coal Co. produced over 312,000 tons of coal from an underground mine at Gillespie. Output was 13 percent less than in 1960. All of it was cleaned by jigging and tabling. About 82 percent of the production was shipped by rail; the remainder was sold for local use.

Vermiculite from Montana was exfoliated at the Girard plant of International Vermiculite Co. and sold mainly for insulation and pipe covering.

Madison.—Lumaghi Coal Co. produced 536,000 tons of coal from an underground mine near Collinsville, and Livingston-Mt. Olive Coal Co. produced 87,000 tons from an underground mine near Livingston. Both companies operated cleaning plants. Total output was 7 percent less than in 1960 and 91 percent of the production was consumed locally.

Limestone for concrete aggregate and roadstone and agricultural uses was produced by Helmkomp Excavating & Trucking Co., C. M. Lohr, Inc., Reliance Whiting Co., and Mississippi Lime Co. The last two companies operated underground mines. The production came mostly from Alton and Godfrey.

Sand and gravel was produced near Alton and Granite City for building and road construction, foundry use, and other purposes. Producers included Alton Sand Co., Gary Dredging Co., Guth Sand Co., and Mississippi Lime Co. The last two companies operated dredges near Alton. The State highway department contracted for paving sand and gravel.

Granite City Steel Co. operated coke ovens and blast and steel furnaces at Granite City. It completed construction of a new blast furnace, the daily capacity of which was about 1,800 tons of pig iron. The new furnace replaced the B furnace that was dismantled in 1960. A new battery of 61 coke ovens also was constructed to support the expanded blast-furnace capacity. The new battery was to produce 1,000 tons of coke daily, and to increase coking capacity about 80 percent. LaClede Steel Co. produced steel from open-hearth furnaces at Alton. The Anlin Company of Illinois recovered elemental sulfur at its refinery in Hartford.

Marion.—Marion County Coal Mining Corp. produced about 24,000 tons of coal from the Glenridge underground mine near Centralia. Part of the mine was in Clinton County but no production was reported from that part of the mine.

Marshall.—Near Sparland, Hydraulic-Press Brick Co. mined clay, which was used for manufacturing building brick. The company also purchased some clay for blending. Four companies at portable plants near Henry, Lacon, and La Rose produced sand and gravel for paving use. The county highway department contracted for paving gravel.

Massac.—Columbia Quarry Co. crushed limestone for roadstone and agricultural purposes. The Massac County Highway Department produced 56,000 tons of paving gravel. The Pope County Highway Department produced 3,200 tons of gravel chiefly for fill. The State highway department contracted for 16,000 tons of paving sand and gravel.

Near Joppa, Missouri Portland Cement Co. began constructing a new cement plant, which was expected to be completed in 1963 and to have an annual capacity of 3 million barrels.

McHenry.—About 3.9 million tons of sand and gravel was produced by 12 companies operating portable or stationary plants near Algonquin, Crystal Lake, Harvard, Hebron, Island Lake, Marengo, and McHenry. This output was used mainly for building construction and road construction. Major producers were Consumers Co., McHenry Sand & Gravel Co., Material Service Corp., and Tonyan Bros., Inc.

Limestone for use as flagging, roadstone, and agricultural use was produced at the Marengo plant of Garden Prairie Stone Co., Inc.

Menard.—Limestone for use as roadstone and agricultural purposes was crushed at stationary plants near Athens by Athens Stone Quarry and Indian Point Limestone Products Co., Inc. Near St. Petersburg, Springfield Clay Products Co. mined clay used for manufacturing building brick and other heavy clay products.

About 10,600 tons of coal was produced from an underground mine near Petersburg. Wilcox-Verna Coal Co., Inc., operated the mine until July, when it was acquired by New Salem Coal Co., Inc. New Salem operated the mine the rest of the year. Total production, 18 percent less than in 1960, was consumed locally.

Mercer.—Hazel Dell Coal Corp. produced 18,000 tons of coal from an underground mine near Alpha. Viola Coal Co. produced about 3,000 tons of coal from a strip mine near Viola. Total coal production was 23 percent less than in 1960; about three-fourths was used locally. Linn Materials Inc., at a stationary plant near Viola crushed limestone for use as roadstone. Hydraulic-Press Brick Co. mined clay near Aledo for use in manufacturing building brick.

Montgomery.—Freeman Coal Mining Corp., the sole producer of coal, produced 2.1 million tons from its Crown underground mine near Farmersville, 6 percent more than in 1960. The entire output was cleaned by jigging and pneumatic methods.

Limestone for roadstone, agricultural use, and riprap was crushed and broken near Litchfield and Nokomis by Central Illinois Stone Co., Chuck Johnson's Quarry, and Nokomis Lime Quarry.

Ogle.—A total of 551,000 tons of sand and gravel was produced from stationary and portable plants near Forreston, Kings, and Oregon. Producers included Kutz Bros. Co., McGrath Sand & Gravel Co., C. C. Macklin, Manley Sand Division of Martin-Marietta Corp. (formerly Portage-Manley Sand Co.), and Floyd Weigle. The output was used for building, paving, railroad ballast, fill, glass manufacture, molding, and pottery. The State highway department contracted for paving sand and gravel.

About 441,000 tons of crushed limestone was produced from quarries near Byron, Oregon, Polo, Rochelle, and Stillman Valley by Material Service, Macklin Bros., McGrath Sand & Gravel Co., Oregon Stone Quarries, and Wesley Young & Sons. It was used as roadstone, agricultural lime, railroad ballast, and blast-furnace flux.

Peoria.—Coal production came from six strip and three underground mines. Nearly 867,000 tons of coal was produced, double that in 1960. Chief reason for the gain was 565,000 tons produced from The United Electric Coal Cos. Banner No. 27 strip mine near Glasford. The mine extended into Fulton County. Three cleaning plants were operated. The output was shipped mostly by barge on the Illinois River. On March 31, Pioneer Collieries Co. sold its strip mine near Laura to Sherwood-Templeton Coal Co., Inc., which operated the mine the remainder of the year.

About 1.4 million tons of sand and gravel was produced by seven companies at plants near Chillicothe and Peoria. This output was used for building and road construction, railroad ballast, fill, and other purposes. Approximately 478,000 tons of crushed limestone for roadstone and agricultural use was produced from three quarries near Princeville by La Mar Stone Co., Long Rock Co., and Princeville Stone Co.

Perry.—Truax-Traer Coal Co. and The United Electric Coal Co. produced coal from strip mines near Pinckneyville and Du Quoin. Total production was 2.6 million tons, a 7-percent decrease from 1960. All of the coal was cleaned at plants operated by the companies. The new Truax-Traer Coal Co. Burning Star No. 2 plant, which began operating in 1960 also processed coal from the company Burning Star No. 1 strip and underground mines in Jackson County. The Burning Star No. 2 mine and preparation plant were described.[3]

Pope.—Auger-mining methods were employed by Auger Mining Co. in producing 42,500 tons of coal near Herod. Operations began in June. The entire output was shipped by barge on the Ohio River.

Fluorspar ore was produced from mines operated by Ozark-Mahoning Co. and J. W. Patton & Sons. The ore mined by Ozark-Mahoning Co. was processed at its plant in Hardin County. A small quantity of ore from the J. W. Patton & Sons mine was processed at a plant in Kentucky.

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[3] Coal Age. Truax-Traer Off to Fresh Start in Southern Illinois. V. 66, No. 6, June 1961, p. 73.

The county highway department leased a pit, which produced 5,800 tons of gravel for fill, from Madeker Gravel Co. Paving gravel was produced under contract for the State highway department.

Pulaski.—Near Ullin, Columbia Quarry Co. produced crushed and broken limestone, which was used for roadstone, railroad ballast, agricultural purposes, filter purposes, and riprap. Star Enterprises, Inc., produced clay near Olmsted. This material was processed and sold for absorbent uses and as a filler for fertilizers and insecticides. Approximately 133,000 tons of sand and gravel, chiefly for road construction, was produced by three companies. Paving gravel was produced under contract for the State highway department.

Randolph.—Coal production was 1.7 million tons, virtually the same as in 1960. Zeigler Coal & Coke Co. produced about 45 percent of the coal from an underground mine near Sparta. The remainder came from two strip mines operated by Southwestern Illinois Coal Corp. and Ritter Coal Co. near Percy and Sparta, respectively. Cleaning plants using jigging methods were operated by Zeigler Coal & Coke Co. and Southwestern Illinois Coal Corp.

Limestone was produced from underground mines operated by Allied Chemical Corp., Chester Quarry Co., and Al Stotz Quarry, and was used for roadstone, agricultural purposes, and in alkali works.

Near Chester, Southern Illinois Sand Co. dredged sand for building, paving, engine use, and fill.

Rock Island.—Limestone for agricultural use and roadstone was crushed near Cordova, Hillsdale, and Milan by Allied Stone Co., Collinson Stone Co., Cordova Quarry, Inc., and Midway Stone Co., Inc. About 579,000 tons of sand and gravel was produced for building and road construction and fill by five companies at plants near Albany, Milan, and Moline. Clay was produced by The Flintkote Co. near Carbon Cliff. The company used the material for manufacturing chimney liners.

St. Clair.—St. Clair County ranked fourth in coal production; its output was 4.4 million tons, 9 percent less than in 1960. A 5-percent gain in strip-mine production failed to offset a 41-percent decline in underground-mine output. About 80 percent of the coal came from three strip mines—the Morgan Coal Co. operation near Millstadt and Peabody Coal Co. Midwest and River King mines near Millstadt and Freeburg, respectively. The River King mine was the largest producing strip mine in the Nation in 1961. Mid-Continent Coal Corp. operated an underground mine near Marissa, and Belle Valley Coal Co. and Shiloh Valley Coal Co. operated underground mines near Belleville. Nearly 99 percent of the coal produced was cleaned, at six preparation plants.

Nearly 2.2 million tons of limestone was produced for roadstone, agricultural use, riprap, and other purposes. Producers included Columbia Quarry Co., East St. Louis Stone Co., Hecker Quarry, Inc., Quality Stone Co., Inc., and Casper Stolle Quarry & Construction Co. East St. Louis Stone Co. installed a 1,050-foot conveyor at its Falling Spring quarry during the year to transport rock from the quarry to the processing plant.

Sand for building, paving, engine use, and fill was produced near East St. Louis. Paving sand was produced under contract for the State highway department.

Hydraulic-Press Brick Co. produced clay near East St. Louis for use in manufacturing lightweight aggregate. Near Belleville, Hill Brick Co. mined clay that was used for manufacturing building brick.

C. K. Williams & Co. ground crude barite mined outside the State at a plant in East St. Louis. This output was sold for filler in rubber and paint and for pharmaceutical purposes.

Operations at the Aluminum Company of America chemical plant which formerly produced aluminum fluoride, gallium, and synthetic cryolite in East St. Louis, were discontinued in late 1961.

The American Zinc Co. of Illinois operated primary zinc smelters at Fairmont City and Monsanto.

Saline.—Approximately 3.1 million tons of coal, a 3-percent increase, was produced. Output from strip mines increased 7 percent, but production from underground mines decreased 2 percent. Seven strip and two underground mines were operated. Major producers were Sahara Coal Co., Inc., and Saxton Coal Corp. Both companies, using jigging methods, operated cleaning plants. About 93 percent of the coal output was shipped by rail, and 6 percent, by barge on the Ohio River; the remainder was consumed locally. H. & V. Coal Co. produced less than 1,000 tons of coal from its strip mine near Equality before it went out of business early in the year. The No. 5 strip mine of New Oak Hill Coal Co. was abandoned in September. A new strip mine was opened by the Black Dot Coal Co.

Sangamon.—About 86,000 tons of coal, a 13-percent decrease, was produced from two underground mines by Cantrall Coal Co. and Eddy Coal Co. near Cantrall and was consumed locally.

Near Springfield, 562,000 tons of sand and gravel was produced from fixed plants by Buckhart Sand & Gravel Co., Inc., Clear Lake Sand & Gravel Co., and Springfield Sand & Gravel Co. The output was used for building and road construction and fill. An additional 17,000 tons of paving sand and gravel was produced under contract for the city of Springfield.

Also near Springfield, Poston Brick & Concrete Products Co. mined clay for manufacturing building brick and lightweight aggregate and Springfield Clay Products Co. produced clay for use in manufacturing draintile and floor and wall tile.

Schuyler.—Coal production increased to 630,000 tons, a 6-percent increase. The Peabody Coal Co. Key strip mine furnished 99 percent of the total. The remainder came from an underground mine operated by D. & D. Coal Co. Both mines were near Rushville. Peabody Coal Co., using jigs, operated a cleaning plant at the Key mine. About 93 percent of the coal was shipped by barge on the Illinois River; 5 percent, by rail; the remainder was used locally.

Near Rushville, Elas Quarry produced 40,000 tons of crushed limestone for use as roadstone and 22,000 tons of sand and gravel for building and paving.

Shelby.—Winter's Stone Quarry crushed nearly 85,000 tons of limestone from the Stewardson quarry near Mode for use as roadstone and agricultural lime.

Hanfland Sand & Gravel Co. produced paving sand and gravel.

Stark.—Coal output was 378,000 tons, more than double that in 1960, as the Allendale strip mine of Stonefort Coal Mining Co., Inc., near Wyoming had its first year of full-scale production. The entire output was cleaned by jigging. Shipments to consumers were mainly by rail. The Allendale operation was described.[4]

L. Roberts Gravel Co. produced 4,500 tons of gravel for fill at a stationary plant near Wyoming.

Stephenson.—Six commercial operators and the county highway department produced a total of 253,000 tons of crushed limestone for roadstone and agricultural purposes.

About 80,000 tons of sand and gravel was mined for building, paving, railroad ballast, and fill. Producers included Freeport Blacktop Co., Stich Sand & Gravel Co., and the county highway department.

Tazewell.—Sand and gravel was produced from stationary and portable plants near East Peoria, Mackinaw, Pekin, and Washington by Hoffer Construction Co., McGrath Sand & Gravel Co., Inc., and C. A. Powley Co. The output was used for building and road construction, railroad ballast, fill, and other purposes.

Peoria Brick & Tile Co. produced clay near East Peoria and used it for manufacturing building brick.

Union.—Approximately 500,000 tons of limestone was crushed and broken near Anna by Anna Quarries, Inc., Jonesboro Stone Co., and Midwest Stone Co. This output was used for roadstone, agricultural purposes, asphalt filler, and riprap. Lutz Marble Co., Inc., produced 2,500 tons of dimension limestone for use as stone veneer for houses. The No. 11 quarry of Columbia Quarry Co. near Lick Creek was closed the entire year. Bittle Construction Co. produced paving sand.

Vermilion.—Coal output in both underground and strip mines increased 2 percent. About 96 percent of the output came from four strip mines and the remainder from three underground mines, all near Danville. Major producers, operating strip mines, were Fairview Collieries Corp. and The United Electric Coal Cos. Cleaning plants were operated by Fairview Collieries Corp. and V-Day Coal Co. Over 72 percent of the coal was shipped by rail; the remainder was consumed locally. Two Rivers Coal Co. abandoned its strip mine in May.

The Material Service Corp. Fairmont quarry crushed limestone chiefly for use as roadstone.

Near Danville, Western Brick Co. mined clay that was used for manufacturing building brick and lightweight aggregate.

About 112,000 tons of sand and gravel was produced for building and road construction and fill. Five companies operated plants near Alvin, Bismarck, Danville, and Westville. Blakeney Gravel Co. did not operate in 1961. Paving gravel was produced under contract for the State highway department.

Wabash.—About 205,000 tons of sand and gravel was produced for building, paving, and fill by Allendale Gravel Co. near Allendale; Dunbar Sand & Gravel Co. near Bellmont; and Mt. Carmel Sand &

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[4] Coal Age. Allendale: Stonefort's Newest in Northern Illinois. V. 66, No, 7, July 1961, p. 80.

Gravel Co. near Mt. Carmel. Paving sand and gravel was produced under contract for the State highway department.

Allendale Coal Co. produced 1,900 tons of coal for local consumption at a strip mine near Allendale.

Washington.—Near Radom, Pitts Quarry produced about 78,000 tons of crushed limestone for roadstone and agricultural use. Coal production was 27,000 tons, 18 percent less than in 1960, chiefly because Bois Coal Co. underground mine near Du Bois was abandoned early in the year. The other coal producer in the county was Venedy Coal Co., Inc., which operated its underground mine near Venedy throughout the year. The coal was produced mostly for local use.

Will.—Nearly 2.4 million tons of limestone was produced for roadstone, agricultural use, railroad ballast, riprap, blast-furnace flux, and other metallurgical uses by Lincoln Stone Co., Material Service Corp., National Stone Co., and the Illinois State Penitentiary.

About 2.7 million tons of sand and gravel was produced for building, paving, railroad ballast, fill, and other uses. Producers included Avery Gravel Co., Chicago Gravel Co., Elmhurst-Chicago Stone Co., Material Service Corp., C. H. Monk, and Peabody Coal Co. Paving gravel was produced under contract for the State highway department.

Peabody Coal Co. produced 389,000 tons of coal from the part of its northern Illinois strip mine in Will County near Wilmington. The mine also extended into Grundy and Kankakee Counties. The entire output was cleaned by jigging.

Johns-Manville Corp. at Joliet processed crude perlite and vermiculite mined in Western States. Expanded perlite was sold for use as lightweight aggregate in plaster, insulation, soil conditioning, and other purposes. Exfoliated vermiculite was used for insulating material.

Williamson.—Williamson County continued to lead in coal production; output was about 6 million tons, 4 percent less than in 1960. Underground and strip-mine output decreased 3 and 8 percent, respectively. Nearly 65 percent of the coal came from 13 underground mines; the remainder came from 6 strip mines. Major producers were Bell & Zoller Coal Co., Carmac Coal Co., Forsyth-Energy Co., Freeman Coal Mining Corp., Stonefort Coal Mining Co., Inc., and Utility Coal Co. Virtually the entire output was processed at 14 cleaning plants; 95 percent was shipped by rail, and the remainder was consumed locally. In September, Forsyth-Carterville Coal Co. closed its strip mine near Carterville. However, with Peabody Coal Co., it formed a joint company to operate the Peabody Energy mine near Herrin under the name of Forsyth-Energy Co. Blue Blaze Coal Co. produced coal intermittently throughout 1961 from its No. 2 shaft mine near Carterville.

Winnebago.—Seven companies produced about 1.9 million tons of sand and gravel for use in building, paving, fill, and other purposes. The South Beloit Sand Co. was dissolved, and its assets were acquired by Illinois-Wisconsin Sand & Gravel Co.

About 750,000 tons of crushed limestone—used for roadstone, agricultural purposes, and riprap—was produced by eight commercial operators and the county highway department.

The Mineral Industry of Indiana

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Conservation.

By Donald F. Klyce[1] and Mary B. Fox[2]

MINERAL PRODUCTION in Indiana was valued at $198 million, $10 million less than in 1960. As the mineral economy of the State is dependent to a large degree upon the construction and mineral fuel industries, smaller demand for building and road materials adversely affected the production of cement, clays, gypsum, aggregates, and finished building stone. Smaller coal shipments indicated a drop in power demand as a major portion of the coal mined in the State was used for generating electric power. Petroleum output also declined and was 7 percent below the 1960 level.

Nonmetals accounted for 53 percent of the value of the State mineral production. The remainder represented the value of mineral fuels, as no metallic minerals were produced.

TABLE 1.—Mineral production in Indiana[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasives (whetstones)……short tons	(2)	(2)	5	$14
Cement, portland……thousand 376-pound barrels	14,052	$48,310	13,780	47,024
Clays……thousand short tons	1,822	3,396	1,362	2,446
Coal, bituminous……do	15,538	61,570	15,106	58,815
Natural gas……million cubic feet	342	61	382	77
Peat……short tons	27,486	290	57,146	502
Petroleum, crude……thousand 42-gallon barrels	12,054	35,439	[3] 11,152	[3] 33,233
Sand and gravel……thousand short tons	20,752	18,377	19,577	16,898
Stone……do	18,956	34,920	18,001	33,062
Value of items that cannot be disclosed: Masonry cement, gem stones, gypsum, and values indicated by footnote 2		8,569		8,436
Total Indiana[4]		[5] 208,247		197,965

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Preliminary figure.

[4] Total adjusted to eliminate duplicating values of clays and stone.

[5] Revised figure.

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[1] Mineral economist, Bureau of Mines, Minneapolis, Minn.

[2] Mineral statistician, Geological Survey, Indiana Department of Conservation, Bloomington, Ind.

A cooperative mapping project between the Indiana Geological Survey and the surveys of adjoining States continued during the year. A geologic map of the Indianapolis 1° x 2° Quadrangle[3] was the result of work done by members of the Indiana and Illinois Surveys. The map is useful to the mineral industries as a guide to the regional distribution of sand and gravel, stone, clay and shale, coal, and peat.

Employment and Injuries.—Preliminary data for the mineral industries indicated that man-hours worked decreased from 1960, reflecting the decline in mineral production in 1961. Twenty-nine fatalities were recorded, compared with five in 1960.

On March 2, 1961 a gas and dust explosion occurred in the Viking mine of the Viking Coal Corp., near Terre Haute, and caused the death of 22 men. Federal investigators were of the opinion that the disaster was caused when an explosive mixture of methane and air was ignited by an arc or spark from electrical equipment in the vicinity or by an open flame and that the explosion was propagated by methane and coal dust.

TABLE 2.—Employment and injuries for selected mineral industries[1]

Year and industry	Average number of men working	Total man-hours	Total number of disabling injuries		Injury frequency rate[2]
			Fatal	Nonfatal	
1960:					
Cement[3]	1,390	3,720,220	--------	6	1.61
Clays[4]	758	1,303,127	--------	40	30.70
Coal (bituminous)	3,548	5,925,303	4	278	47.59
Coke ovens	2,120	6,167,387	--------	10	1.62
Limestone[5]	2,656	5,210,876	--------	160	30.71
Marl	24	25,440	--------	--------	--------
Sand and gravel	1,184	2,457,244	--------	47	19.13
Sandstone	96	149,880	1	9	66.72
1961:[6]					
Cement[3]	1,284	3,507,485	1	2	.85
Clays[4] [7]	1,492	2,857,332	--------	34	11.90
Coal (bituminous)	3,319	5,543,626	27	295	58.08
Coke ovens	1,357	3,968,170	--------	19	4.79
Limestone[5]	2,516	4,882,888	1	145	29.90
Marl	17	16,240	--------	--------	--------
Sand and gravel	1,074	2,248,183	--------	14	6.23
Sandstone	91	127,675	--------	--------	--------

[1] Excludes officeworkers.
[2] Total number of injuries per million man-hours.
[3] Includes cement plants and quarries or pits producing raw material used in manufacturing cement.
[4] Excludes pits producing clay used exclusively in manufacturing cement.
[5] Excludes quarries producing limestone used exclusively for manufacturing cement.
[6] Preliminary figures.
[7] Includes some plants not previously reporting.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Hindostan Whetstone Co. of Bedford quarried sandstone near Orleans in Orange County. The material was milled into sharpening stones and into tapered stones for use as cuticle remover.

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[3] Wier, C. E., and H. H. Gray. Geologic Map of the Indianapolis 1° x 2° Quadrangle, Indiana and Illinois, showing bedrock and unconsolidated deposits. Ind. Geol. Survey Regional Geol. Map, Indianapolis Sheet, 1961.

Cement.—Portland and masonry cements were produced in plants operated by Universal Atlas Cement Co. at Buffington in Lake County, Lehigh Portland Cement Co. at Mitchell in Lawrence County, Lone Star Cement Co. at Limedale in Putnam County, and Louisville Cement Co. at Speed in Clark County. Louisville Cement Co. began construction in February of a second Indiana plant at Logansport in Cass County. It will be a wet-process plant with an annual capacity of 1.2 million barrels. In December, Lehigh Portland Cement Co. completed a $17 million expansion program at its Mitchell plant in Lawrence County, bringing annual capacity to 2.5 million barrels. The average mill values of portland and masonry cements varied little from the previous year. Average price of portland cement was $3.41 a barrel, compared with $3.44 in 1960. Masonry cement was $2.75, compared with $2.79 in 1960. At the beginning of 1961, the reporting unit for masonry cement was changed from 376-pound barrels to 280-pound barrels. For purposes of comparison, 1960 shipments were converted to 280-pound barrels.

Shipments of portland cement were about 270,000 barrels less than in 1960, while shipments of masonry cement were slightly larger. Yearend stocks of portland cement at mills were 2 million barrels, 533,000 barrels more than at the beginning of 1961.

More than 60 percent of the shipments of portland cement went to ready-mixed concrete companies, and the balance was distributed nearly equally among building material dealers, concrete product manufacturers, and highway and other contractors. About 43 percent of the cement shipped was used in Indiana. Out-of-State shipments went principally to Illinois, Kentucky, and Wisconsin, with smaller quantities going to 12 other States, principally in the eastern and southern parts of the United States. More than 3.2 million tons of limestone and over 1 million tons of clay, shale, slag, sand, and gypsum were used in manufacturing cement. More than 342 million kilowatt-hours of electrical energy was used at the plants. Cement was manufactured by the dry process at three plants and by the wet process at one. The annual finished cement capacity of the four plants exceeded 18 million barrels.

Clays.—Fire clay was mined in seven counties for use principally in manufacturing heavy clay products, floor and wall tile, and refractories. Small quantities were used by manufacturers of stoneware, terra cotta, and art pottery. Fire clay production was slightly less than in 1960.

Miscellaneous clay was mined in 21 counties. It was used chiefly in the manufacture of cement, lightweight aggregate, brick, sewer tile, and draintile. Requirements for these uses were substantially less than in 1960, and clay output declined by 400,000 tons.

Figures compiled by the Indiana Geological Survey indicated that the value of products manufactured from clay and shale was $28.1 million. Also, the survey published[4] a report on the refractory clays of Indiana.

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[4] Harrison, J. L. Refractory Clays of Indiana. Ind. Geol. Survey Rept. of Progress No. 25, 1961, 18 pp.

TABLE 3.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	506	$964	1,237	$1,756	1,743	$2,720
1957	398	748	1,077	1,821	1,475	2,569
1958	315	518	1,056	1,959	1,371	2,477
1959	366	565	1,326	2,350	1,692	2,915
1960	348	635	1,474	2,761	1,822	3,396
1961	334	588	1,028	1,858	1,362	2,446

Gem Stones.—Calcite specimens were found at a quarry near North Vernon and also in the Kentland area. Also in the Kentland area, the sale of "shatter cones" for exhibit purposes was reported.[5] In the Bloomington area, geodes and nodules were found. The value of gem stone output in Indiana was negligible compared with that of other minerals.

Gypsum.—Production of crude gypsum was 9 percent less than in 1960 owing to a smaller demand from the building industry. Mines and plants were operated near Shoals, in Martin County, by National Gypsum Co. and United States Gypsum Co. Lath, wallboard, prepared plaster, and other products were manufactured.

Mineral Wool.—Blast-furnace slag from steel mills in Lake County was the principal raw material used to manufacture mineral wool. Small quantities of clay, gravel, and limestone also were used. Plants were in Huntington, Madison, Wabash, and Wayne Counties.

Perlite.—Crude perlite was expanded in plants at Hammond and Vienna. Its principal uses were for building plaster, concrete aggregate, and insulation. The crude perlite was mined in Colorado and New Mexico.

Sand and Gravel.—Output of sand and gravel was 6 percent less than in 1960. Value declined 8 percent. The greatest decrease (1.3 million tons) was reported in materials used for road construction. Sand and gravel for building use declined by 343,000 tons.

Industrial sands, principally molding, fire, and engine sand, were also in less demand, with output falling about 150,000 tons below the 1960 level. Demand for fill material continued to grow, and output was about 700,000 tons greater than in 1960. Commercial production was reported from 67 counties by 174 producers.

County highway departments in 13 counties produced sand and gravel.

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[5] "Shatter cones" are conical fragments of rock characterized by striations that radiate from the apex and are formed when the parent rock is subjected to a sudden shearing stress so intense that the splintering of the rock ignores the natural lines of fracturing weakness. One of the ways in which shatter cones are formed is by the deformation resulting from meteorite impact. This origin has been suggested for the shatter cones near Kentland.

TABLE 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Molding	420	$578	(1)	(1)
Building	4,081	3,242	4,063	$3,274
Paving	3,296	2,666	2,810	2,252
Engine	92	107	69	105
Fire or furnace	136	153	134	237
Fill	1,030	395	1,191	388
Undistributed [2]	92	64	441	687
Total [3]	9,147	7,205	8,709	6,943
Gravel:				
Building	3,640	4,002	3,336	3,685
Paving	5,579	5,697	4,874	4,780
Railroad ballast	385	310	139	122
Fill	1,401	812	1,898	958
Other	50	76	154	172
Total [3]	11,055	10,897	10,400	9,717
Total sand and gravel	20,202	18,102	19,109	16,660
Government-and-contractor operations:				
Sand:				
Paving	1	(5)	-------	-------
Fill	(4)	(5)	-------	-------
Other	-------	-------	1	(5)
Total	1	(5)	1	(5)
Gravel:				
Building	55	36	35	19
Paving	423	210	323	185
Fill	71	29	110	33
Total [3]	549	275	467	238
Total sand and gravel	550	275	468	238
All operations:				
Sand	9,148	7,205	8,710	6,944
Gravel	11,604	11,172	10,868	9,955
Grand total [3]	20,752	18,377	19,577	16,898

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.
[2] Includes glass, filtration sand, and other industrial sands.
[3] Data do not add to totals shown because of rounding.
[4] Less than 500 short tons.
[5] Less than $500.

Marion County led in sand and gravel production by a wide margin. Value of output was nearly $4 million. Large production also was reported from Allen, Kosciusko, St. Joseph, Vermillion, and Vigo Counties.

The 10 leading producers, in alphabetical order, were Aggregate Services of Jeffersonville, Inc., Louisville, Ky.; American Aggregates Corp., Indianapolis; Paul C. Brudi Stone & Gravel Co., Inc., Fort Wayne; Interstate Sand & Gravel Co., Inc., Covington; Irving Bros. Gravel Co., Inc., Marion; Irving Materials, Inc., No. 2, Fortville; Material Service Corp., Chicago, Ill.; May Stone & Sand, Inc., Fort Wayne; Standard Materials Corp., Indianapolis; Western Indiana Gravel Co.; Lafayette.

Slag (Iron-Blast Furnace).—Slag was a byproduct of pig-iron production in Lake County blast furnaces. It was crushed for use as an aggregate, expanded for lightweight aggregate, and used in the manufacture of roofing granules, mineral wool, and cement.

Stone.—Stone production was reported from 53 counties. More than 97 percent of the output was crushed for use in cement, concrete aggregate, roadstone, filler, flux, mineral food, railroad ballast, and agriculture.

Production of stone was about 5 percent lower in quantity and value than in 1960. Most of the decrease was in crushed limestone, particularly material used for concrete aggregate and roadstone. The volume of dimension stone produced was slightly larger, although value declined. Increased quantities of rough architectural block were shipped for milling elsewhere, and lesser quantities of the higher-priced dressed stone were shipped from the Bedford-Bloomington district.

Crushed limestone was produced in 44 counties. The largest output came from Putnam, Clark, Lawrence, Allen, Bartholomew, Monroe, and Newton Counties. Major producers included Louisville Cement Co. (for its own use), May Stone & Sand, Inc., Meshberger Stone Corp., Mulzer Bros., Newton County Stone Co., Inc., The Ohio & Indiana Stone Corp., and Standard Materials Corp.

Dimension limestone, quarried principally in Lawrence and Monroe Counties, accounted for one-third of the value but less than 3 percent of the tonnage of limestone produced. Leading producers were Bloomington Limestone Corp., Empire Stone Co., B. G. Hoadley Quarries, Inc., Victor Oolitic Stone Co., and Woolery Stone Co., all in or near Bloomington, and Indiana Limestone Co., Inc., and Ingalls Stone Co. in the Bedford area.

Also in the Bloomington-Bedford area were 15 independent finishing mills, where purchased stone, mainly rough block, was fabricated into building stone.

The Indiana Geological Survey published[6] a guidebook on the stratigraphy of Silurian rocks of northern Indiana.

Calcareous marl was dug from pits in seven counties. Two-thirds of the production came from Kosciusko and Steuben Counties.

Standstone was quarried in four counties. Production for building purposes was reported by Indiana Sandstone Co., Inc., Leonard Sandstone Co., Inc., Spice Valley Sandstone Co., Inc., and Springs Valley Sandstone Co., all in Lawrence County; by Hinkle Sandstone Co. in Monroe County; and by French Lick Sandstone Co. in Orange County. General Refractories Co. produced quartz conglomerate in Martin County for use in manufacturing refractories.

Roofing granules were made from iron blast furnace slag by H. B. Reed & Co., Inc., of Hammond.

Sulfur.—Byproduct sulfur was recovered from crude petroleum at the Whiting refinery of American Oil Co. The Mathieson-Fluor process was used.

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[6] Shaver, R. H., and others. Stratigraphy of the Silurian Rocks of Northern Indiana. Field Conf. Guidebook No. 10, Ind. Geol. Survey, May 1961, 62 pp.

TABLE 5.—Limestone sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension and building:				
Rough construction..........thousand short tons..	....	....	1	$15
Rough architectural (block)..thousand cubic feet..	2,817	$2,934	2,820	3,159
Dressed (cut or sawed)....................do....	3,374	8,345	2,995	7,459
Flagging and rubble.......................do....	1,103	221	1,559	339
Total (approximate thousand short tons) [1]........	529	11,500	536	10,972
Crushed and broken:				
Riprap....................thousand short tons..	300	371	44	49
Concrete aggregate, roadstone, etc............do....	13,245	16,695	12,746	16,040
Railroad ballast..........................do....	419	523	203	253
Agricultural..............................do....	2,095	2,870	2,002	2,776
Cement....................................do....	2,037	1,582	2,176	1,531
Other [2]...................................do....	227	715	205	728
Total.....................................do....	18,323	22,756	[3] 17,375	21,377
Grand total...............................do....	18,852	34,256	17,911	32,349

[1] 145 pounds per cubic foot.

[2] Includes limestone for mineral wool (1960), filter beds and stone sand (1961), flux, chemicals, whiting or whiting substitutes, asphalt filler, fertilizer, dust for coal mines, mineral food, poultry grit, and other miscellaneous uses.

[3] Data do not add to totals shown because of rounding.

TABLE 6.—Calcareous marl production

Year	Number of producers	Short tons	Value	Year	Number of producers	Short tons	Value
1952–56 (average).	6	35,026	$22,046	1959..............	8	62,589	$39,979
1957..............	7	103,452	65,011	1960..............	9	56,406	38,389
1958..............	7	60,196	39,637	1961..............	9	31,707	19,137

MINERAL FUELS

Coal (Bituminous).—Coal production declined 3 percent in quantity; value dropped 5 percent because of a price decrease to $3.89 per ton from $3.96 per ton in 1960. Seventy-two mines were operated, nine less than in 1960. Of these, 32 were underground mines and 40 were strip mines. Over 11.2 million tons of coal was cleaned mechanically at 18 plants. About 11.1 million tons of coal was moved by rail, 1.9 million tons by water, 1.5 million tons by truck, and most of the balance by conveyors.

Mining-equipment sales to Indiana coal producers included one continuous mining machine and one scraper and room conveyor. Fifty-five mobile loading machines and 13 continuous mining machines were in use. More than 98 percent of the coal mined underground was loaded mechanically.

About three-fifths of the coal mined was consumed by electric utility companies. Coal was mined in 15 counties of which 5 (Greene, Pike, Sullivan, Vigo, and Warrick) supplied more than 83 percent of the total.

TABLE 7.—Coal (bituminous) production in 1961, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production, short tons			Value
	Underground	Strip	Underground	Strip	Total	
Clay	1	7	1,313	769,649	770,962	$3,179,337
Daviess	-	1	-	44,661	44,661	196,113
Dubois	3	1	21,563	2,895	24,458	101,094
Fountain	-	1	-	4,050	4,050	20,250
Gibson	2	-	602,144	-	602,144	(1)
Greene	2	5	6,050	1,326,533	1,332,583	5,291,015
Knox	2	1	348,527	278,358	626,885	2,457,170
Owen	-	2	-	(1)	(1)	(1)
Parke	-	2	-	(1)	(1)	(1)
Pike	4	4	109,340	2,044,142	2,153,482	8,217,998
Spencer	1	3	6,033	(1)	(1)	(1)
Sullivan	5	2	1,656,739	60,492	1,717,231	7,083,902
Vermillion	3	1	11,736	1,400	13,136	82,053
Vigo	4	1	1,539,095	460,806	1,999,901	8,396,587
Warrick	5	9	306,329	5,048,579	5,354,908	19,232,889
Undistributed	-	-	-	455,741	461,774	4,556,401
Total	32	40	4,608,869	10,497,306	15,106,175	58,814,809

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.

The Indiana Geological Survey published [7] maps showing geology and coal deposits in western and southwestern Indiana. Also, a bulletin was published [8] on the composition of Indiana coals.

Coke.—Coke was produced at 5 plants with 2,218 ovens. Output of nearly 7.7 million tons was 4 percent smaller than in 1960. Value of the product was $133 million, compared with $156 million in 1960.

Over 11.5 million tons of coal was delivered to the coke plants, of which 10.8 million was carbonized for coke production. About 90 percent of the coal delivered came from Kentucky and West Virginia. None was mined in Indiana. Most of the coke produced was used in Lake County blast furnaces.

Peat.—Peat (humus, moss, and reed-sedge) was produced from bogs in Benton, Blackford, Grant, Hamilton, Huntington, and Marion Counties. Output reported was double that of 1960. The peat was sold principally for soil-conditioning and horticultural purposes. None was sold for use as a fuel.

TABLE 8.—Peat production

Year	Number of producers	Short tons	Value	Year	Number of producers	Short tons	Value
1952–56 (average)	7	9,902	$55,698	1959	5	15,393	$202,094
1957	8	13,805	129,750	1960	7	27,486	290,338
1958	5	12,106	144,974	1961	7	57,146	501,850

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[7] Friedman, S. A. Geology and Coal Deposits of the Terre Haute and Dennison Quadrangles, Vigo County, Ind. Coal Inv. Map No. C 44, Ind. Geol. Survey, 1961.

Hutchison, H. C. Distribution, Structure, and Mined Areas of Coals in Fountain and Warren Counties and the Northernmost Part of Vermillion County, Ind. Preliminary Coal Map No. 9, Ind. Geol. Survey, 1961.

[8] Neavel, R. C. Petrographic and Chemical Composition of Indiana Coals. Ind. Geol. Survey Bull. 22, 1961, 81 pp.

Petroleum and Natural Gas.—Records of the Indiana Geological Survey showed that 554,500 fewer barrels of oil were produced than in 1960. The number of wells drilled also decreased—from 1,133 in 1960 to 906. Of the 906 wells drilled, 788 were primary wells, 4 were gas storage wells, and 114 were wells for waterflooding purposes. The 542 field-development wells included in the primary well category consisted of 206 oil wells, 10 gas wells, and 326 dry holes. The remaining 246 wells were wildcats and resulted in 12 new field discoveries, 10 extensions of existing fields, and 8 new pay zones.

Of the wells drilled, 72 percent were in seven counties: Posey, 183 wells; Spencer, 153 wells; Gibson, 141 wells; Pike, 72 wells; Dubois, 38 wells; Vanderburgh, 35 wells; and Knox, 31 wells. The remaining drilling was done in 38 other counties.

Exploration was most successful in Mississippian rocks, with 23 successful wildcats, 7 new pools, 8 extensions, and 8 new pays, followed by Ordovician rocks, with 5 wildcats, 3 new pools, and 2 extensions, and Devonian rocks, with 2 wildcats and 2 new pools. The 30 successful wildcat wells were drilled in 14 counties and of these wells, 17 were in Gibson, Pike, and Posey Counties. Four shallow Chester reservoirs were discovered in southeastern Pike County in an area which had not been intensively tested.

Waterflooding of a Bethel standstone reservoir in the Claypole Hills Consolidated field in southwestern Knox County, initiated in 1961, resulted in an increase to 129,027 barrels over the 24,218 barrels produced in 1960. Approximately 36 percent of the State's total production was attributed to secondary recovery methods.

TABLE 9.—Crude petroleum production in 1961, by major fields [1]

Name	Field			Number of wells		Production, barrels
	Year discovered	Area, acres	Location, county	Producing	Completed	
Black River Consolidated	1950	510	Posey	31	9	112,986
Caborn Consolidated	1940	1,690	do	137	3	332,632
Claypole Hills Consolidated	1944	380	Knox	31	0	129,027
College Consolidated	1941	660	Posey	54	0	100,789
Griffin Consolidated	1938	6,720	Gibson & Posey	695	15	2,236,437
Heusler Consolidated	1938	1,760	Posey & Vanderburgh	117	20	300,882
Inman East	1943	360	Posey	31	0	129,014
Lamott Consolidated	1941	1,320	do	97	5	161,111
Mount Vernon Consolidated	1941	2,000	do	171	4	271,510
Mumford Hills	1940	850	Gibson & Posey	67	2	233,936
Owensville Consolidated	1940	1,660	Gibson	138	3	244,591
Patoka East Consolidated	1947	990	do	70	2	126,596
Plainville	1950	350	Daviess	55	0	118,685
Point	1942	570	Posey	51	32	330,819
Powells Lake Consolidated	1942	440	do	44	1	372,403
Princeton North Consolidated	1943	830	Gibson	67	2	119,733
Springfield Consolidated	1946	2,310	Posey	269	1	1,171,529
Union-Bowman (New) Consolidated.	1941	14,290	Gibson, Knox, and Pike	618	18	988,345
Union Chapel East	1959	300	Spencer	23	4	109,007
Vienna	1933	320	Vanderburgh	48	0	133,169
Welborn Consolidated	1941	1,570	Posey	141	6	199,939
Wheatonville Consolidated	1949	1,440	Gibson	126	12	193,715
Undistributed				2,108	106	3,382,760
Total				5,189	245	11,499,615

[1] Petroleum Section, Indiana Geological Survey.

Exploration for underground gas storage sites, mostly in northern Indiana, continued throughout the year. In October injection of propane gas was started in a large underground storage cavern near Oakland City in Gibson County.

At the end of the year, the proved oil reserve was 62,031,000 barrels, and the total liquid hydrocarbon reserve was 62,133,000 barrels.[9]

METALS

Aluminum.—Aluminum Company of America operated a smelter in Warrick County, a plant at Richmond for the production of closures, and plants at Fort Wayne and Lafayette for the production of insulated copper and aluminum magnet wire, and tube and extrusions.

Pig Iron and Steel.—Pig iron and steel were produced at East Chicago by Inland Steel Co. and Youngstown Sheet & Tube Co., and at Gary by United States Steel Co.

Output of pig iron was about 8.9 million tons, 5 percent larger than in 1960.

The American Iron and Steel Institute reported that steel production in Indiana increased to 14 million tons, compared with 13.8 million tons in 1960. Nearly 6.3 million tons of coke and 3.4 million tons of limestone and dolomite were used at integrated steel plants.

New manufacturing facilities, including a six-stand cold reduction mill, a continuous galvanizing line, and a continuous annealing line, were put into operation by Youngstown Sheet & Tube Co., at its Idiana Harbor plant.

The six-stand mill was said to be the largest and fastest in the steel industry for rolling steel tinplate strip, with a rated top speed of 7,250 feet per minute. It could be brought to maximum speed in 14 seconds and stopped in 7 seconds. The mill was the first of its kind using six stands of rolls in tandem instead of the conventional four and five stands; the added stand permits the rolling of strip at high speeds because the work normally required of four or five stands can be spread out over six.

REVIEW BY COUNTIES

Mineral production valued at more than $1 million, excepting petroleum and natural gas, was reported from each of 18 counties, 4 less than in 1960.

About 58 percent of the State total came from nine counties: Clark, Lake, Lawrence, Monroe, Pike, Putnam, Sullivan, Vigo, and Warrick. Most of the output of cement, coal, and dimension stone was from these counties. No mineral production was reported from Brown, Franklin, Ohio, and Union Counties. Petroleum and natural gas production and value are included in the State total but a breakdown by counties was not available.

Approximately two-thirds of the petroleum was estimated to have come from fields in Gibson and Posey Counties. In some instances, fields covered parts of more than one county, so that actual county production could not be determined.

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[9] American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. 1961, Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. V. 16, 27 pp.

TABLE 10.—Value of mineral production in Indiana, by counties[1] [2]

County	1960	1961	Mineral production in 1961 in order of value [2]
Adams	$492,908	$495,241	Stone, clays, sand and gravel.
Allen	1,950,074	(3)	Stone, sand and gravel.
Bartholomew	533,000	802,900	Stone.
Benton	(3)	(3)	Peat, sand and gravel.
Blackford	(3)	(3)	Stone, clays, peat.
Boone	78,770	94,695	Sand and gravel.
Carroll	(3)	(3)	Stone, sand and gravel.
Cass	509,956	511,277	Do.
Clark	(3)	(3)	Cement, stone, sand and gravel, clays.
Clay	4,079,841	3,419,546	Coal, clays, sand and gravel.
Clinton	(3)	32,500	Sand and gravel.
Crawford	(3)	(3)	Stone.
Daviess	260,719	256,682	Coal, sand and gravel.
Dearborn	(3)	156,965	Sand and gravel.
Decatur	(3)	(3)	Stone.
DeKalb	204,095	155,554	Sand and gravel.
Delaware	1,144,547	948,109	Stone, sand and gravel.
Dubois	124,701	154,105	Coal, clays, sand and gravel.
Elkhart	336,508	360,499	Sand and gravel, stone (marl).
Fayette	(3)	(3)	Sand and gravel.
Floyd	(3)	(3)	Do.
Fountain	581,356	428,422	Sand and gravel, clays, coal.
Fulton	40,813	37,808	Sand and gravel, stone (marl).
Gibson	(3)	(3)	Coal, sand and gravel.
Grant	(3)	(3)	Stone, sand and gravel, peat.
Greene	6,321,180	5,487,577	Coal, clays, sand and gravel, stone.
Hamilton	1,107,558	945,823	Stone, sand and gravel, peat.
Hancock	35,530	57,320	Sand and gravel.
Harrison	256,530	236,736	Stone.
Hendricks	(3)	(3)	Sand and gravel.
Henry	(3)	(3)	Do.
Howard	361,812	(3)	Stone, sand and gravel.
Huntington	(3)	632,825	Stone, sand and gravel, clays, peat.
Jackson	204,472	148,109	Clays, sand and gravel.
Jasper	(3)	(3)	Stone, sand and gravel.
Jay	93,400	112,631	Do.
Jefferson	----------------	(3)	Stone.
Jennings	389,021	161,162	Do.
Johnson	169,970	296,019	Sand and gravel.
Knox	3,758,855	2,760,053	Coal, sand and gravel.
Kosciusko	521,545	439,152	Sand and gravel, stone (marl).
Lagrange	413,634	230,578	Do.
Lake	(3)	(3)	Cement, clays, sand and gravel.
LaPorte	(3)	(3)	Sand and gravel, stone (marl).
Lawrence	10,065,896	10,800,426	Cement, stone.
Madison	1,024,732	1,027,939	Stone, sand and gravel.
Marion	3,699,515	4,079,373	Sand and gravel, peat.
Marshall	66,100	65,530	Sand and gravel.
Martin	3,186,735	(3)	Gypsum, stone, clays.
Miami	333,929	230,294	Sand and gravel.
Monroe	8,399,353	7,354,948	Stone.
Montgomery	65,713	94,715	Clays, sand and gravel.
Morgan	1,232,880	846,885	Clays, sand and gravel, stone.
Newton	(3)	(3)	Stone, sand and gravel.
Noble	(3)	(3)	Sand and gravel, stone (marl).
Orange	654,245	727,032	Stone, abrasives (whetstones).
Owen	2,263,324	2,493,217	Coal, stone, clays, sand and gravel.
Parke	399,484	388,780	Sand and gravel, clays, coal.
Perry	(3)	(3)	Stone, clays.
Pike	7,368,017	8,221,998	Coal, stone.
Porter	309,950	262,205	Sand and gravel, clays.
Posey	75,594	72,543	Sand and gravel.
Pulaski	(3)	(3)	Stone, clays, sand and gravel.
Putnam	(3)	(3)	Cement, stone, sand and gravel, clays.
Randolph	316,742	342,809	Stone, sand and gravel.
Ripley	442,609	285,952	Stone.
Rush	(3)	255,163	Stone, sand and gravel.
St. Joseph	633,948	596,467	Sand and gravel.
Scott	819,396	261,205	Stone.
Shelby	877,287	629,996	Stone, sand and gravel.
Spencer	(3)	(3)	Coal, sand and gravel.
Starke	33,409	40,322	Sand and gravel.
Steuben	208,869	180,401	Sand and gravel, stone (marl).
Sullivan	6,105,515	7,281,522	Coal, sand and gravel, stone.
Switzerland	(3)	123,454	Stone, sand and gravel.
Tippecanoe	(3)	(3)	Sand and gravel.
Tipton	(3)	(3)	Do.
Vanderburgh	(3)	(3)	Stone, clays.
Vermillion	680,694	797,541	Sand and gravel, clays, coal.

See footnotes at end of table.

TABLE 10.—Value of mineral production in Indiana, by counties—Continued

County	1960	1961	Mineral production in 1961 in order of value [2]
Vigo	$11,556,826	$8,956,154	Coal, sand and gravel, clays.
Wabash	133,485	120,679	Stone, sand and gravel.
Warren	608,913	399,571	Sand and gravel.
Warrick	20,311,551	19,516,889	Coal, stone, sand and gravel.
Washington	225,000	225,810	Stone, sand and gravel.
Wayne	804,612	642,437	Sand and gravel, stone.
Wells	(3)	(3)	Stone, sand and gravel.
White	424,600	336,550	Stone.
Whitley	(3)	422,430	Sand and gravel.
Undistributed	103,633,073	103,064,157	
Total [4]	[5] 208,247,000	197,965,000	

[1] Brown, Franklin, Ohio, and Union Counties did not report production.

[2] Natural gas and petroleum production is not available by counties; included with "Undistributed."

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[4] Total adjusted to eliminate duplicating value of clays and stone.

[5] Revised figure.

Adams.—Clay, limestone, and sand and gravel were produced. Krick-Tyndall Co. of Findlay, Ohio, mined clay near Decatur for use in manufacturing heavy clay products. Limestone was quarried and crushed at Lynn Grove and Pleasant Mills by Meshberger Bros. Stone Corp. for use as roadstone and for agricultural purposes. John W. Karch Stone Co., Bryant, quarried limestone for flagging, roadstone, and agstone. Building materials were obtained from a sand and gravel pit near Geneva by Lybarger Gravel Co.

Allen.—May Stone & Sand Co., Inc., produced limestone and sand and gravel in the Fort Wayne area. The limestone was crushed and sold for blast-furnace flux, roadstone, and agricultural limestone.

Sand and gravel for building, road use, and fill was mined and processed at Harlan by Irving Gravel Co., Inc., and at Fort Wayne by Paul C. Brudi Stone & Gravel Co. and May Stone & Sand Co., Inc.

Bartholomew.—Meshberger Stone Corp. operated a limestone quarry and crushing plant near Elizabethtown. The material was used for asphalt filler, filter beds, stone sand, roadstone, and agstone.

Benton.—Millburn Peat Co., Inc., of Chicago, Ill., mined moss peat near Otterbein. The material was sold in bulk and packaged form for horticultural use and soil conditioning. Road material was obtained from a gravel pit near Fowler by Mt. Gilboa Gravel Co.

Blackford.—Inman Tile Co. mined clay near Hartford City for its own use in manufacturing draintile. Hartford Peat & Gravel Co. dug reed-sedge peat from a bog near Hartford City for sale in bulk to the horticultural trade and for soil improvement. J. & K. Stone Co., Muncie, quarried and crushed stone from the Montpelier quarry for concrete aggregate and road use.

Carroll.—Delphi Limestone Co. quarried and crushed limestone near Delphi for agricultural use and road purposes. Gravel for road use and fill was mined from pits near Delphi and Flora.

Cass.—Limestone was quarried and crushed by France Stone Co. of Toledo, Ohio, at the Keeport quarry and by the Cass County Stone Co. at Logansport. Roadstone, agstone, riprap, fluxstone, and railroad ballast were produced. Sand and gravel for building, paving. and fill was mined in the county.

Louisville Cement Co. began constructing a cement plant at Logansport.

Clark.—Louisville Cement Co. manufactured portland and masonry cements at Speed and mined clay and limestone near the plant for its own use.

Limestone quarries and crushing plants were operated at Sellersburg by Sellersburg Stone Co. and in the Jeffersonville area by Atkins Stone Co. and by Louisville Sand & Gravel Co. The output was sold mainly for road use and agricultural purposes. Also in the Jeffersonville area, large quantities of sand and gravel were mined for building and road use.

Clay.—Coal was produced from seven strip mines and one underground mine. The largest production came from the Chinook strip mine of Ayrshire Collieries Corp. Quality Coal Corp. ceased production at the Quality strip mine in May, when the mine was acquired by Center Point Block Coal Corp., which resumed production in September.

Fire clay and miscellaneous clay were mined at several sites and sold or used for manufacturing vitrified sewer pipe, structural tile, building brick, heavy clay products, and cement.

Road material was obtained from a gravel pit near Carbon.

Crawford.—Limestone quarries and crushing plants were operated near Marengo by Hy-Rock Products Co. and at Eckerty by Mulzer Bros. The quarry at Marengo was one of the few underground quarries being operated in the State. The crushed stone was sold for concrete aggregate, roadstone, railroad ballast, and for agricultural purposes.

Daviess.—Coal was produced from a strip mine by P. & R. Coal Co. Building sand and building and paving gravel were obtained from a pit near Elnora by Mize Gravel Co.

Decatur.—Limestone quarries and crushing plants were operated at Greensburg by Harris City Stone Corp., at Westport by Layton Stone Co., and at New Point by New Point Stone Co. Most of the material was sold for road use and agricultural purposes.

Delaware.—Limestone for road use was quarried and crushed in the Muncie area by J. & K. Stone Co. and Muncie Stone & Lime Co. Sand and gravel pits in the same area yielded a considerable quantity of material for building and road use.

Lower Niagaran rocks underlying the glacial material were being quarried and crushed by Irving Bros. Stone & Gravel Co. near Muncie. Formerly only sand and gravel was mined at this site.

Dubois.—Coal was mined from three underground mines and one strip mine. Stoneware, fire brick, and building brick were manufactured from fire clay and miscellaneous clay mined near Huntingburg Sand for building use was obtained from a pit near Portersville.

Elkhart.—Marl for agricultural use was dug from pits near Goshen by Aschliman & Weirich and near Elkhart by E. M. Ulmer & Son. Building and paving material were obtained from five sand and gravel operations near Elkhart and Goshen.

Floyd.—In November, a large commercial limestone quarry was opened at Greenville by Standard Materials Corp. of Indianapolis.

Company plans included construction of port and storage facilities on the Ohio river, at New Albany.

Fountain.—Miscellaneous clay was mined and used for making building brick at Attica and Veedersburg. Clay mined near West Point was used in the manufacture of inorganic plastics. Coal was produced from the Warnick strip mine. Sand and gravel pits and plants near Attica, Covington, and Kingman produced building and paving materials and railroad ballast.

Fulton.—Marl for soil conditioning was obtained from a pit near Kewanna. Sand and gravel pits in the Rochester area yielded building and paving materials.

Gibson.—Coal was produced from the underground mines of Princeton Mining Co. and Somerville Coal Co. Sand and gravel was obtained from three sites.

Some of the most prolific oil fields in the State were wholly or partly in Gibson County. The Griffin Consolidated field, partly in Posey County, yielded over 2.2 million barrels. The Owensville Consolidated, Patoka East Consolidated, and Wheatonville Consolidated fields, entirely in the county, yielded nearly 600,000 barrels. The Union-Bowman (New) Consolidated field in Gibson, Knox, and Pike Counties produced about 1 million barrels.

Grant.—Pipe Creek Stone Co. quarried and crushed limestone near Sweetzer for blast-furnace flux, roadstone, and agstone. Flagging also was obtained from the quarry. Sand and gravel for building and road use and for fill was mined in the Marion area. Moss peat was obtained from a bog near Jonesboro.

Greene.—Coal was produced from five strip and two underground mines. The Airline mine of Alva Coal Corp. and the Friar-Tuck mine of Ayshire Collieries Corp. were the leading producers. Lambright Coal Co. abandoned its strip mine at Bloomfield in April. Alvin Lohr Coal Co. abandoned its V. J. No. 5 strip mine near Switz City.

Fire clay and miscellaneous clay were mined near Bloomfield and Switz City and used or sold for making building brick. Limestone was quarried and crushed by Gordon & Shepherd Stone Co. of Shelburn for road and agricultural use. Sand and gravel was mined near Bloomfield.

Hamilton.—Stony Creek Stone Co., Inc., operated a quarry and crushing plant near Noblesville. Most of the output was used for concrete aggregate and roadstone. Peat was dug from bogs near Noblesville by East Side Peat Moss and Fox Prairie Products, Inc. Five operators produced sand and gravel for building and road use.

Harrison.—Roadstone and agricultural limestone were quarried and crushed near Corydon by Mathes Stone Quarry and Corydon Crushed Stone & Lime Co. Davis Crushed Stone & Lime Co., at Depauw, produced riprap, poultry grit, roadstone, and agstone.

Howard.—Yeoman Stone Co., Kokomo, produced cut stone, flagging, and crushed stone for road use and agricultural purposes. The city of Kokomo produced fill gravel for its own use.

Huntington.—Miscellaneous clay was mined at Majenica and Simpson and used in the manufacture of draintile. Erie Stone Co. operated the Huntington limestone quarry and produced blast-furnace flux, railroad ballast, and stone for agricultural and road use. Heller

Stone Co. quarried and crushed limestone for road use at Markle. Sand and gravel were mined near Andrews. Moss peat was obtained from a bog near Warren by Ballards Peat Moss.

Jackson.—Miscellaneous clay was mined by Lehigh Portland Cement Co. for its own use. Clays mined at Brownstown and Medora were used in building brick and heavy clay products. Sand and gravel were obtained at Brownstown and Seymour for building and paving.

Jasper.—Limestone was quarried and crushed at Rensselaer by W. C. Babcock Construction Co. for road and agricultural use. Building sand was obtained in the same area.

Jay.—Rockledge Products, Inc., Portland, produced roadstone and agstone. Building and paving materials were obtained from sand and gravel pits.

Jefferson.—Standard Materials Corp. of Indianapolis operated the Hanover quarry and produced riprap and crushed stone for concrete aggregate and road and agricultural use.

Jennings.—The North Vernon quarry was operated by Berry Materials Corp. The output was crushed for roadstone and agricultural use.

Knox.—Coal was mined from one strip mine and two underground mines. The Shasta Coal Corp. strip mine at Bicknell was abandoned in October. Sand and gravel pits near Vincennes yielded building and paving materials.

Kosciusko.—Marl for agricultural use was obtained from pits near Atwood and Milford. Over 500,000 tons of sand and gravel was produced at six sites. Most of the material was used for building, paving, and fill, although engine sand and railroad ballast also were produced.

Lagrange.—Marl for soil conditioning was dug from a pit at Howe by Glen Hesher Marl Co. Sand and gravel production was reported by five operators.

Lake.—Portland and masonry cements were produced at Buffington by Universal Atlas Cement Co. Limestone shipped by water from Michigan and slag from nearby blast furnaces were the principal raw materials used. National Clay Co., of Chicago, Ill., mined clay at Munster for use in building brick. John N. Bos Sand Co. produced industrial sands near Gary. Byproduct sulfur was recovered from crude petroleum at Whiting by American Oil Co. Roofing granules were produced from slag by H. B. Reed Co., Hammond.

Pig iron and steel were produced at Gary by United States Steel Corp. and at East Chicago by Inland Steel Co. and Youngstown Sheet & Tube Co. Refractories were produced at East Chicago, Gary, and Hammond.

La Porte.—Industrial sands (molding, engine, and glass) were mined at Michigan City by Manley Sand Division of Martin-Marietta Corp. and Producers Core Sand Corp. J. & A. Gravel Co., La Porte, produced building and paving material. A deposit near Walkerton yielded marl for agricultural use.

Lawrence.—Dimension limestone was quarried in and near Bedford by Indiana Limestone Co., Inc., and Ingalls Stone Co. Rough block, purchased from local quarries, was fabricated into building stone by several independent stone mills.

Bedford Ground Limestone Co. produced finely ground limestone for use in mineral food, glass manufacture, and agriculture, from spalls purchased from stone mills. Limestone was quarried and crushed by Ralph Rogers & Co., Inc., at Springville, by Mitchell Crushed Stone Co. and Lehigh Portland Cement Co. at Mitchell, and by Oolitic Ground Limestone Co. at Bedford. Most of the output was used in cement, concrete aggregate, roadstone, and agstone.

Dimension sandstone was quarried and milled for use as building stone by Indiana Sandstone Co., Leonard Sandstone Co., Spice Valley Sandstone Co., and Springs Valley Sandstone Co. Portland and masonry cements were produced at Mitchell by Lehigh Portland Cement Co.

Madison.—Standard Materials Corp. operated the Lapel quarry and crushed limestone for agricultural use, concrete aggregate and roadstone. Materials for building, paving, and fill were produced at five sand and gravel operations.

Marion.—Large quantities of sand and gravel were mined and processed at several locations in the Indianapolis area. The material was used for building, paving, and fill. Peat Moss, Inc., Indianapolis, produced reed-sedge and humus peat and sold it in bulk and packaged form for soil conditioning and horticultural use.

Martin.—Loogootee Clay Products Corp. manufactured building brick from clay mined near Loogootee. General Refractories Co. quarried and processed quartz conglomerate near Shoals. The material was used in refractories. Crude gypsum was mined in the Shoals area by National Gypsum Co. and United States Gypsum Co. The crude material was processed at plants adjoining the mines. Mill output included wallboard, prepared plasters, and lath.

Monroe.—Limestone and sandstone were produced. Dimension limestone was quarried and milled by Ed Bennett Stone Co., Bloomington Limestone Corp., Empire Stone Co., B. G. Hoadley Quarries, Inc., Independent Limestone Co., Indiana Limestone Co., Inc., Ingalls Stone Co., McNeely Quarries, Inc., Midwest Quarries Co., Paul W. Smith Stone Co., Texas Quarries, Inc., Victor Oolitic Stone Co., and Woolery Stone Co., Inc. Most of the stone quarried was milled at plants in or near Bloomington and Bedford. Several independent mills fabricated purchased stone. Indiana Calcium Corp. operated a fine grinding plant at Bloomington. Spalls purchased from stone mills were ground for a variety of industrial uses.

Bloomington Crushed Stone Co. operated a quarry and plant near Bloomington. The output was sold for concrete aggregate, roadstone, and agricultural use. Sandstone was quarried and milled near Bloomington for building use by Hinkle Sandstone Co.

Montgomery.—Clay was mined from pits near Crawfordsville and used in making building brick and vitrified sewer pipe. A small quantity of paving gravel was obtained from pits in the Crawfordsville area.

Morgan.—Clayton Winders & Sons quarried and crushed limestone near Lewisville for use in concrete aggregate, roadstone, and agstone. Morgan County Gravel Co., Inc., Martinsville, produced sand and gravel for building and paving. Building brick, vitrified sewer pipe, and lightweight aggregate were manufactured from miscellaneous clay mined near Brooklyn and Martinsville.

Newton.—Newton County Stone Co. operated a limestone quarry and plant east of Kentland and produced material for concrete aggregate, roadstone, and agricultural limestone. Building and paving material was obtained from a sand and gravel pit near Morocco.

Noble.—Luther & Haney sold marl mined near Albion for soil conditioning. Four operators produced sand and gravel for fill, building, and paving.

Orange.—French Lick Sandstone Co., Inc., milled sandstone at French Lick from material quarried in Lawrence and Martin Counties. Limestone deposits near Paoli and Orleans were quarried, and the material was crushed for road and agricultural use.

Whetstones were manufactured at a mill near Orleans by Hindostan Whetstone Co. from sandstone quarried in the area. The deposits of fine-grained sandstone had yielded material for whetstones and other abrasive products for 160 years. As early as the 1820's, the finished stones were shipped by flatboat to New Orleans via the White, Wabash, Ohio, and Mississippi Rivers and thence to many markets abroad.

Owen.—Coal was produced from the Old Glory (Alva Coal Corp.) and Burcham (Burcham Bros., Inc.) strip mines. Fire clay was mined from the Old Glory pit and sold to producers of floor and wall tile, architectural terra cotta, and building brick. Dimension limestone was quarried from the Ramona quarry by Ingalls Stone Co. and milled at Bedford. Dunn Limestone Co., owned by American Aggregates Corp. of Greenville, Ohio, also operated in the Ramona quarry and produced riprap, fluxstone, roadstone, railroad ballast, and agstone. In December, American Aggregates Corp. began erecting a new plant in the bottom of the old Midwest quarry near Spencer, formerly operated by France Stone Co. Clayton Winders & Sons quarried and crushed limestone for road and agricultural use. Building and paving materials were obtained from two sand and gravel pits.

Parke.—Coal was mined from the Maple Grove and Turner strip mines. The Turner mine also yielded fire clay, which was sold for making building brick. Cayuga Brick & Tile Co. mined miscellaneous clay for its own use. Sand and gravel pits near Montezuma and Rockville yielded materials for building and road use.

Perry.—Mulzer Bros. operated a limestone quarry and crushing plant at Derby. The output was sold for concrete aggregate, roadstone, and agstone. U.S. Brick Co. mined clay at Tell City for its own use.

Pike.—Four strip and four underground coal mines were operated. The largest output came from the strip mines of Enos Coal Mining Co. The Ayrshire Collieries Corp. Ayrshire strip mine was not operated in 1961. On January 1, 1961, Enos Coal Mining Co. acquired the properties formerly operated by Blackfoot Coal & Land Corp. Riprap was quarried by the Pike County Highway Department, for its own use, from an abandoned strip mine.

Porter.—Clay mined near Chesterton was sold for making art pottery, stoneware, and refractories. Industrial sand was mined near Crisman, and gravel for fill was obtained near Valparaiso.

Posey.—More than half of the major oilfields in the State were located wholly or partly in Posey County. The county also led in the number of new wells drilled. Small quantities of sand and gravel were produced at two sites.

Pulaski.—In the Francesville area, clay was mined for making draintile, and limestone was quarried and crushed for road and agricultural use. Building and paving materials were obtained from a sand and gravel pit near Monterey.

Putnam.—Portland and masonry cements were manufactured at Limedale by Lone Star Cement Corp. The company mined clay and quarried and crushed limestone near the plant for its own use. Indiana State Farm mined clay and quarried limestone at Greencastle. The materials were used by State agencies and were not for commercial sale. Limestone quarries and crushing plants were operated at Greencastle by Ohio & Indiana Stone Corp., at Manhattan by Standard Materials Corp., at Russellville Stone Co., Division of Gorham Construction Co., Inc., and at Cloverdale by Midway Stone Co. In November, Standard Materials Corp. opened a new quarry and crushing plant northeast of Greencastle. Sand and gravel was produced near Reelsville.

Randolph.—The output of limestone quarries and crushing plants at Albany and Ridgeville was used for concrete aggregate, roadstone, and agricultural limestone. Sand and gravel pits at Farmland and Lynn yielded materials for fill and building and paving use.

Ripley.—Limestone quarries and crushing plants were operated at Versailles by Berry Materials Corp. and Cord Stone Co., at Napoleon by New Point Stone Co., and at Osgood by South Eastern Materials Corp. Most of the material was used in concrete aggregate and for roadstone and agricultural use.

Rush.—Limestone quarried and crushed at Milroy by McCorkle Stone Co. and Rush County Stone Co. was used principally for road construction and agricultural purposes. Road and fill materials were obtained from three gravel pits.

Scott.—Scott County Stone Co., Inc., operated the Hardy quarry and crushed the output for concrete aggregate and highway and agricultural use.

Shelby.—The output of limestone quarries at Flat Rock and St. Paul was sold mainly for road use, railroad ballast, and agricultural purposes. Building, paving, and fill material were obtained from a sand and gravel pit near Shelbyville.

Spencer.—Three strip mines and one underground coal mine were operated. Molding sand was mined by Hardy Sand Co. at Sandale.

Steuben.—Marl was produced from pits near Hudson and used for soil conditioning. Sand and gravel was mined at four sites.

Sullivan.—Coal was produced at five underground and two strip mines. Fairview Collieries Corp. abandoned the Hoosier Gem mine in March. Kixmiller Bros. produced roadstone and agstone near Freelandsville. Sand and gravel was produced at three sites.

Switzerland.—Tri-County Stone Co. operated a limestone quarry and crushing plant near Cross Plains and produced asphalt filler, agstone, and roadstone. The Switzerland County Highway Department produced limestone for its own use.

Vanderburgh.—The West Franklin quarry, near Evansville, was operated by Mulzer Bros. The output was used mostly in concrete aggregate and for roadstone. Bedford-Nugent Co., Evansville, processed sand and gravel dredged from the Ohio River. Standard Brick and Tile Corp. mined clay near Evansville for its own use.

Vermillion.—Coal was produced from three underground mines and one strip mine. The Blanford mine was acquired by Black Diamond Mining Corp. in October. Blue Bird Coal Co. began producing from an underground mine at Clinton. White Coal Co. did not operate its strip mine near Clinton during 1961.

Arketex Ceramic Corp. mined fire clay from the Dana pit near Newport for use in manufacturing glazed structural tile. Building brick was manufactured from clay mined near Cayuga by Cayuga Brick Corp. Sand and gravel pits and processing plants were operated near Cayuga by Material Service Corp. of Chicago and at Clinton by Standard Materials Corp. of Indianapolis. Building, paving, and fill materials were produced.

Vigo.—Coal production was reported from one strip mine and four underground mines. The Chieftain strip mine and the Green Valley and Viking underground mines were the leading producers. Terre Haute Vitrified Brick Works, Inc., mined clay for its own use. Sand and gravel was produced at four sites.

Wabash.—Mill Creek Stone Co. quarried and crushed limestone near Wabash for filler and road use. Sand and gravel was produced at sites near Somerset and Wabash.

Warrick.—Coal production was reported from nine strip mines and five underground mines. The B. & B. Coal Co. closed its strip mine in October. The Simpson mine, which had been abandoned because of a fire in February 1960 was acquired by Reed Mining Co. in September; no coal was produced in 1961. Enos Coal Mining Co. acquired the Blackfoot strip mine on January 1.

Limestone quarries were operated by Lemmons & Co., Inc., and Sunlight Coal Co. Road materials were produced. Midwest Sand & Gravel dredged sand and gravel from the Ohio River.

Washington.—Hoosier Lime & Stone Co. produced road material from a limestone quarry near Salem.

Wayne.—DeBolt Stone Quarry, Richmond, produced riprap, road material, and agricultural limestone. Sand and gravel was produced near Richmond, Hagerstown, and Cambridge City. Most of the material was used for fill and for building and paving.

Wells.—Erie Stone Co. operated a limestone quarry and crushing plant near Bluffton. Most of the output was used in concrete aggregate and roadstone. Paving gravel was mined in the Bluffton area.

White.—Monon Crushed Stone Co. operated a quarry and plant near Monon and produced agricultural limestone, railroad ballast, and road material.

The Mineral Industry of Iowa

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Iowa.

By Samuel A. Gustavson [1]

◆

MINERAL production in Iowa continued at a near record high level in 1961. The total value of State produced minerals consumed was $90.7 million, about $4.4 million less than in 1960; however, nearly 40 percent of this decline in value resulted from lower unit values for several commodities. Vigorous competition for markets led to lower average unit values for portland and masonry cements, coal, sand and gravel, peat, and crushed limestone for some uses. Unit values for crude clay and gypsum were slightly higher in 1961; but, unlike most other State produced commodities sold in an open market, both crude clay and gypsum are for the most part consumed by the producer in the manufacture of finished products. Therefore, the somewhat arbitrary unit values for these minerals tend to follow trends in leasing or royalty fees and mining costs.

TABLE 1.—Mineral production in Iowa [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland……thousand 376-pound barrels..	12,105	$42,330	12,108	$41,718
Masonry……thousand 280-pound barrels..	554	1,874	557	1,843
Clays……thousand short tons..	1,022	1,346	1,044	1,426
Coal (bituminous)……do....	1,068	3,845	927	3,323
Gypsum……do....	1,283	5,428	1,239	5,276
Sand and gravel……do....	14,692	13,516	13,391	11,651
Stone……do....	23,185	30,321	22,018	28,916
Value of items that cannot be disclosed: Other nonmetals	----------	660	----------	845
Total Iowa [2]	----------	95,030	----------	90,674

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Total adjusted to eliminate duplicating value of clays and stone.

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[1] Chief, Pittsburgh Field Office, Division of Mineral Resources, Bureau of Mines, Pittsburgh, Pa.

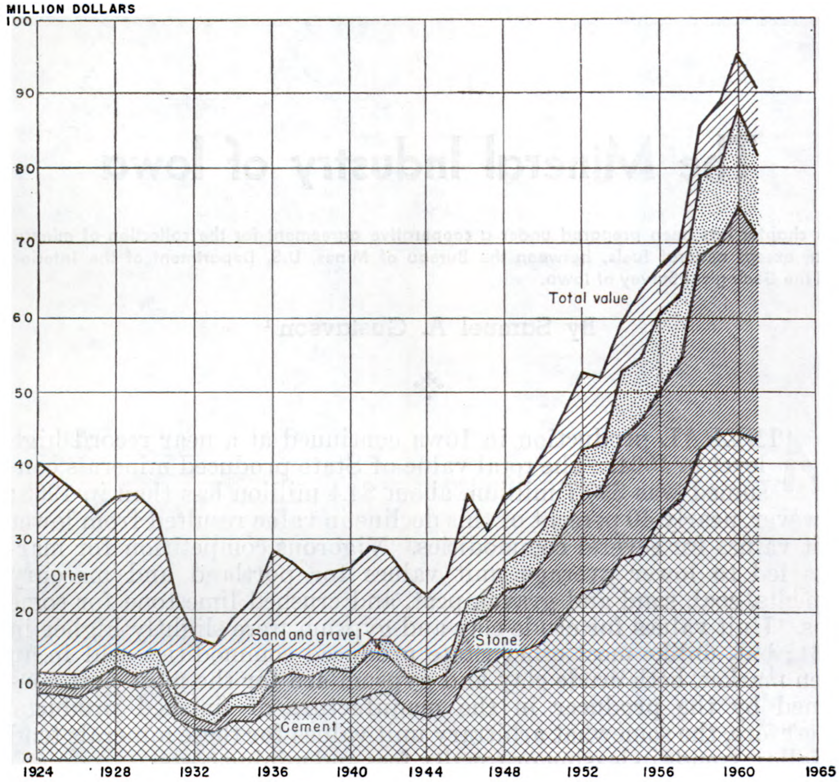

FIGURE 1.—Value of cement, stone, sand and gravel, and total value of mineral production in Iowa, 1924–61.

Employment and Injuries.—Data on cement, coal, and gypsum employment and injuries were based on 100-percent coverage for each industry. Labor data were partially estimated for the clay, sand and gravel, and stone industries.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement by Iowa producers totaled 12,107,705 barrels, a slight increase over 1960. The value of these shipments, however, was 1 percent less than in 1960, as increasing competition tended to weaken the price structure. The average mill price per barrel for Iowa producers was $3.45, compared with $3.50 in 1960. Output of cement was greater than sales, and stocks rose from 1,357,467 barrels (adjusted figure) on January 1 to 1,910,340 barrels on December 31, 1961.

There had been no change in the number of cement plants in the State for several years. Capacity of individual plants had on occasion

TABLE 2.—Employment and injuries for selected mineral industries[1]

Year and industry	Average number of men working	Total man-hours	Total number of lost-time injuries		Injury frequency rate[2]
			Fatal	Nonfatal	
1960:					
Cement[3]	1,083	2,658,584	----------	3	1.13
Clays[4]	350	732,973	1	18	25.92
Coal (bituminous)	470	762,541	----------	23	30.16
Gypsum	461	961,669	----------	----------	----------
Limestone[5]	1,339	3,011,754	----------	107	35.53
Sand and gravel	1,247	2,396,664	2	42	18.36
1961:[6]					
Cement[3]	1,097	2,630,579	----------	5	1.90
Clays[4]	399	812,806	----------	26	31.99
Coal (bituminous)	423	617,622	----------	21	34.00
Gypsum	204	473,224	----------	1	2.11
Limestone[5]	1,338	2,893,048	----------	56	19.36
Sand and gravel	1,191	2,236,781	----------	12	5.36

[1] Excludes officeworkers.
[2] Total number of injuries per million man-hours.
[3] Includes cement plants and quarries or pits producing raw material used in manufacturing cement.
[4] Excludes pits producing clay used exclusively in manufacturing cement.
[5] Excludes quarries producing limestone used exclusively for manufacturing cement and lime.
[6] Preliminary figures.

been increased. In 1961, Northwestern States Portland Cement Co. added 1 kiln, 400 feet long, having an internal diameter of 13 feet at the upper end and 11½ feet at the lower end. This additional kiln plus upward adjustments in capacity at other plants increased the total portland cement production capacity for all plants from slightly over 14 million barrels to nearly 15.5 million barrels per year. Two plants were in Cerro Gordo County, two in Polk County, and one in Scott County.

Types I and II, general-use and moderate-heat cements, and type III, high-early-strength cement, were produced at all five plants. A total of 28 kilns were in operation—1 more than in 1960. Three companies used a wet process, and two, a dry process. The five plants consumed 289 million kilowatt-hours of electrical energy, of which 112 million kilowatts was home generated and 177 million was purchased.

Markets for the cement were chiefly in Iowa and Minnesota, followed by Illinois, Wisconsin, South Dakota, Nebraska, and North Dakota. Reports from the companies indicated sales of 1.9 million barrels of portland cement to building manufacturers; 1.9 million barrels to concrete products manufacturers; 5.9 million barrels to ready-mixed-concrete producers; 1.8 million barrels to highway contractors; 0.5 million barrels to other contractors; and less than 50,000 barrels for other uses.

Mixed hydraulic and masonry cements were produced at all except the Penn-Dixie Cement Corp., plant No. 8, in West Des Moines, Polk County. Sales of masonry cements increased slightly in 1961; however, average value declined. The average price per 280-pound barrel was $3.31, compared with $3.38 in 1960. Market distribution, in order of quantity, was to Minnesota, Iowa, Wisconsin, Illinois, North Dakota, South Dakota, and Nebraska.

Clays.—Consumption and sales of shale and clay increased 2 percent over 1960, as increases in tonnage used in the manufacture of lightweight aggregate and cement offset declines in consumption for manufacture of heavy clay products (draintile and building brick), refractories, and mortar mix. Sales of crude clay were indicated by only 3 of the 25 companies reporting production. The remaining companies used their entire output in their own manufacturing plants. Companies selling crude clay or shale were Nelson Clay Products Co. in Keokuk County; Goodwin Tile & Brick Co., with operations in both Polk and Warren Counties; and Vincent Clay Products Co. in Webster County. Nelson Clay Products Co. classed its product as fire clay. All of the clay sold was reportedly used in the manufacture of heavy clay products. These companies also manufactured building brick, building tile, draintile, and other heavy clay products. Lightweight aggregate from clay or shale was produced by only one company. Carter-Waters Corp. of Kansas City, Mo., mined expandable shale from a deposit near Centerville, Appanoose County, and expanded it in a rotary kiln. Production of fire clay was reported by four companies. Three companies used fire clay in manufacturing heavy clay products, but Grarok, Inc., made fire clay mortar. Of the total clay produced, 48 percent was used in the manufacture of cement, 41 percent was used in heavy clay products, and the remainder was used chiefly in lightweight aggregate, fire clay mortar, and masonry cement.

Gypsum.—The United States Gypsum Co. formally opened its Sperry plant on March 29. The underground mine and surface plant are near Sperry in Des Moines County. In spite of this new addition, total sales of gypsum and gypsum products produced in Iowa declined 3 percent following a decline in building construction in the central States. The number of companies producing gypsum in Webster County remained unchanged; they were Bestwall Gypsum Co., Celotex Corp., National Gypsum Co., and the United States Gypsum Co. Webster County gypsum mines were all open pits.

All companies made a wide variety of gypsum products including base-coat plaster, ready-mixed and other special-use plasters, gypsum lath, wallboard, sheathing, tile, other preformed items, and pulverized gypsum. The chief markets were in the building industry, cement manufacture, agriculture, and as a filler; minor markets were in the glass and pottery industries, and for miscellaneous molding uses. The estimated unit value of crude gypsum was $4.26 per ton, compared with $4.23 in 1960.

Lime.—Linwood Stone Products Co., Inc., with a plant near Buffalo in Scott County was the State's only producer of quicklime and hydrated lime for commercial sale. Sales of quicklime were about the same as in 1960, while sales of hydrated lime were slightly more. This company was also the only commercial producer in 1960. In 1961, production data in table 1 include quicklime and hydrated lime produced for internal use by American Crystal Sugar Co. at a plant in Mason City in Cerro Gordo County as well as production for commercial sale. Both companies used high calcium limestone as their crude material. Principal uses were for water treatment, steel (open-hearth furnaces), sugar refining, and sewage treatment. The market area was Iowa and several adjacent States. American Crystal Sugar Co.

used a shaft kiln, and Linwood Stone Products Co., Inc., was a rotary kiln.

Perlite.—Producers of gypsum products expanded crude perlite from Colorado, Nevada, and New Mexico mines for use in premixed, lightweight plasters.

Sand and Gravel.—Overall production of sand and gravel was down about 9 percent from 1960; however, the 1961 sale or use of 13,391,430 tons, valued at $11,651,409, was exceeded only in 1959 and in 1960. Commercial sales for building and highway use declined as home and building construction decreased. Output of sand and gravel by Government-and-contractor producers was greater than in 1960. Competition for highway contracts was severe. Average unit values in 1961 for some uses of sand and gravel did increase a few cents, but unit values for other uses and the overall average unit values for sand and gravel declined in spite of continued increases in labor and materials costs.

Production of industrial sand increased over 1960. Uses included molding sand, blast sand, engine sand, and filter sand. Most of the molding sand was produced from a friable sandstone deposit in Clayton County.

About 6 percent of the commercial sand and gravel was sold as unwashed pit-run material; transportation of all output was chiefly by truck.

Most sand and gravel deposits in the State have a high ratio of sand to gravel; consequently, the value of sand is usually lower than that for gravel. As a result of the lower-than-normal supply of gravel, more crushed limestone was used for a coarse aggregate and gravel was shipped in from adjacent States.

The 10 leading producers, of which several operated in more than one area of the State, are alphabetically listed.

Acme Fuel & Material Co., Muscatine.
Concrete Materials & Construction Division, Martin Marietta Co., Cedar Rapids.
Coon Valley Gravel Co., Des Moines.
Everds Brothers, Algona.
L. G. Everist, Inc., Sioux Falls, S. Dak.
Hallett Construction Co., Crosby, Minn.
Ronald Kenyon Construction Co., West Des Moines.
Mauldlin Construction Co., Webster City.
Northern Gravel Co., Muscatine.
Van Dusseldorp Construction Co., Colfax.

Stone.—Limestone production was reported for 60 of Iowa's 99 counties in 1961, and, except for a small quantity of river boulders, limestone was the only type of stone produced in the State. Stone production was about 1 million tons less than in 1960 but was greater than that of any other prior year. Agricultural use of limestone declined 15 percent. The average unit value per ton of agricultural stone also declined and was $1.35 per ton in 1961, compared with $1.38 per ton in 1960. Dimension stone production nearly doubled. A small tonnage of rubble stone was produced by Weber Dehn Construction Co. in Delaware County. Production of sawed stone slabs, house stone veneer, and rubble stone was reported by Becker Stone Quarry in Dubuque County and by William C. Weber Stone Co. in Jones County.

TABLE 3.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,888	$2,547	2,560	$2,178
Paving [1]	1,642	1,528	1,379	1,160
Railroad ballast	19	14	(2)	(2)
Fill	671	321	475	241
Undistributed [3]	168	560	171	522
Total	5,388	4,970	4,585	4,101
Gravel:				
Building	1,567	2,403	1,521	2,300
Paving [1]	4,784	4,346	3,842	3,034
Fill	342	153	111	64
Undistributed [4]	83	133	95	166
Total	6,776	7,035	5,569	5,564
Total sand and gravel	12,164	12,005	10,154	9,665
Government-and-contractor operations:				
Sand:				
Building	----------	----------	1	(5)
Paving [1]	37	15	49	27
Fill	17	6	12	9
Other	----------	----------	3	2
Total	54	21	65	38
Gravel:				
Paving [1]	2,437	1,470	3,157	1,942
Fill	8	2	----------	----------
Other	29	18	15	6
Total	2,474	1,490	3,172	1,948
Total sand and gravel	2,528	1,511	3,237	1,986
All operations:				
Sand	5,442	4,991	4,650	4,139
Gravel	9,250	8,525	8,741	7,512
Total	14,692	13,516	13,391	11,651

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[1] Includes materials for bridges, culverts, and other uses.
[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[3] Includes sand for other uses, molding, blast, engine, filter, and other industrial uses.
[4] Includes railroad ballast and other gravel.
[5] Less than $500.

Limestone used for riprap increased 17 percent in tonnage. There was about a 7-percent decline in tonnage of crushed stone, used as a concrete aggregate, and of roadstone, produced by commercial companies; however, Government and highway contractors produced 21 percent more than in 1960. Production of limestone for cement manufacture increased 2 percent and "other uses" declined 11 percent. Other uses included metallurgical flux, mineral food, railroad ballast, chemical uses, and filler.

The 10 leading producers of limestone are listed alphabetically.

B. L. Anderson, Inc., Cedar Rapids.
Concrete Materials & Construction Division, Martin-Marietta Co., Cedar Rapids.
Dewey Portland Cement Co., Kansas City, Mo.
Kaser Construction Co., Des Moines.
Linwood Stone Products Co., Inc., Davenport.

TABLE 4.—Limestone sold and used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial:				
Agriculture	1,296	$1,787	1,102	$1,483
Dimension	5	80	10	151
Riprap	254	380	297	403
Concrete aggregate, roadstone, and similar materials	17,498	23,007	16,308	21,570
Cement	3,345	3,621	3,417	3,691
Other [1]	217	939	192	971
Total	22,615	29,814	21,326	28,269
Government-and-contractor, all uses (concrete aggregate, roadstone, riprap)	570	507	692	647
Grand total	23,185	30,321	22,018	28,916

[1] Includes limestone for filter beds and stone sand (1960), chemical for other uses (1961), asphalt filler, dust for coal mines, fertilizer, fluxing, mineral food, lime, railroad ballast, and other uses.

Missouri Valley Limestone Co., Oakland.
Penn-Dixie Cement Corp., Nazareth, Pa.
E. I. Sargent Quarries, Inc., Des Moines.
Schildberg Construction Co., Greenfield.
Weaver Construction Co., Iowa Falls.

MINERAL FUELS

Coal (Bituminous).—Coal mining continued to decline, and for the first time since 1874 production was less than 1 million tons. The 1961 output was 927,156 tons—a decline of 13 percent from 1960. Virtually all the coal produced was consumed within the State in the production of electric power or for heating public buildings. About 60 percent was hauled to destination by rail, and 38 percent, by truck. Means of transportation for the remaining 2 percent was not reported. Five fewer deep mines and one additional strip mine operated in 1961 than in 1960. The average price for coal in 1961 was $3.58 per ton—2 cents a ton less than in 1960. The average price for coal from deep mines was $4.41 and that from strip mines, $3.43 per ton.

In the 14 operating underground coal mines, there were 14 cutting machines, 11 hand-held or post-mounted drills, and 1 mobile drill used in mining; 6 electric locomotives and 4 shuttle cars were used in haulage. The 26 strip mines used 30 power shovels with a capacity of less than 3 cubic yards, 3 power shovels with a capacity between 3 and 5 cubic yards, 12 draglines with buckets with a capacity of less than 3 cubic yards, 12 draglines with 3- to 5-cubic-yard buckets, 2 draglines with 6- to 12-cubic-yard buckets, and 1 dragline with a bucket of over 12 cubic yards; 43 bulldozers; 25 horizontal power drills; 13 vertical power drills; and 68 trucks. Of the total of 60 power shovels and draglines, 4 were electric, 2 diesel electric, 40 diesel, and 14 gasoline operated. Again as in 1960, only 3 companies employed more than 20 men in their mining operations.

Peat.—Peat was produced from bogs in Worth and Winnebago Counties by Colby Pioneer Peat Co. and Eli Colby Co. The pH

TABLE 5.—Coal (bituminous) production in 1961, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value
	Underground	Strip	Underground	Strip	Total	
Appanoose	8		47,080		47,080	$256,614
Lucas	1	1	24,524	4,287	28,811	138,861
Mahaska		8		228,427	228,427	774,452
Marion	2	10	60,009	450,135	510,144	1,746,908
Monroe	3	2	15,943	25,331	41,274	141,209
Van Buren		1		11,584	11,584	60,818
Wapello		4		59,836	59,836	203,806
Total	14	26	147,556	779,600	927,156	3,322,668

value of the peat produced is almost neutral. Both companies had processing plants at Hanlontown and sold peat in bulk or packaged.

REVIEW BY COUNTIES

Counties for which no mineral production was reported in 1961 were Audubon, Davis, Ida, Monona, Page, Ringgold, Shelby, and Wayne. Some limestone or sand and gravel may have been produced in these counties, as several companies reporting production of these materials did not submit a breakdown showing output by county of origin. Data covered production of commercial and Government-and-contractor producers of sand and gravel and of limestone. Estimates were made for a few nonreporting companies producing these commodities. Estimates were based on previous reports and other sources of information, notably reports submitted by State, county, and municipal highway departments.

Appanoose.—Carter-Waters Corp. produced lightweight aggregate from expandable shale mined near Centerville; this company was the only producer of lightweight aggregate from clays or shales in the State. Adel Clay Products Co. of Centerville produced brick and other heavy clay products from clay mined in the county.

Eight underground coal mines were operated during the year. Operating companies were Appanoose Coal Co., Clarke Coal Co., D. C. Coal Co., New Block Coal Co., New Gladstone Coal Co., Riverside Coal Co., Shamrock Coal Co., and Sunshine Coal Co. Limestone was also produced in the county; output was about 400,000 tons.

Benton.—Garrison Brick & Tile Works manufactured heavy clay products, chiefly draintile. Some sand and gravel and crushed limestone were produced.

Boone.—Clay for refractory mortar was produced by Grarok, Inc., from a pit near the city of Boone.

Cerro Gordo.—About a quarter of the State's total mineral value was produced in Cerro Gordo County. Two cement plants, Lehigh Portland Cement Co. and Northwestern State Portland Cement Co., manufactured types I and II, general-use and moderate-heat cement, and type III, high-early-strength cement. Both plants also produced

TABLE 6.—Value of mineral production in Iowa, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Adair	(2)	(2)	Stone.
Adams	(2)	(2)	Stone, sand and gravel.
Allamakee	$74, 213	$42, 138	Do.
Appanoose	1, 093, 772	908, 280	Stone, coal, clays.
Audubon	(2)	----------	
Benton	(2)	(2)	Sand and gravel, stone, clays.
Black Hawk	1, 094, 044	453, 706	Stone, sand and gravel.
Boone	(2)	(2)	Sand and gravel, clays.
Bremer	6, 200	5, 560	Sand and gravel, stone.
Buchanan	152, 066	132, 699	Stone, sand and gravel.
Buena Vista	205, 574	231, 906	Sand and gravel.
Butler	206, 756	232, 140	Stone, sand and gravel.
Calhoun	87, 571	28, 644	Sand and gravel.
Carroll	185, 149	165, 617	Do.
Cass	(2)	(2)	Stone, sand and gravel.
Cedar	502, 764	(2)	Stone.
Cerro Gordo	23, 392, 562	24, 765, 105	Cement, stone, clays, lime, sand and gravel.
Cherokee	363, 503	456, 274	Sand and gravel.
Chickasaw	(2)	(2)	Stone.
Clarke	(2)	(2)	Do.
Clay	154, 590	168, 368	Sand and gravel.
Clayton	(2)	(2)	Do.
Clinton	(2)	(2)	Stone, sand and gravel.
Crawford	137, 346	83, 465	Sand and gravel.
Dallas	449, 241	355, 726	Sand and gravel, clays.
Decatur	(2)	(2)	Stone, sand and gravel.
Delaware	383, 504	339, 251	Do.
Des Moines	529, 746	863, 153	Gypsum, stone, sand and gravel.
Dickinson	47, 600	50, 323	Sand and gravel.
Dubuque	473, 416	470, 100	Stone, sand and gravel.
Emmet	115, 231	165, 437	Sand and gravel.
Fayette	257, 040	294, 303	Stone, sand and gravel.
Floyd	399, 570	379, 107	Stone, sand and gravel, clays.
Franklin	335, 626	381, 382	Sand and gravel, stone, clays.
Fremont	(2)	60, 732	Stone.
Greene	332, 556	(2)	Sand and gravel.
Grundy	(2)	(2)	Stone, sand and gravel.
Guthrie	(2)	(2)	Sand and gravel.
Hamilton	396, 214	93, 018	Sand and gravel, stone.
Hancock	337, 475	318, 721	Do.
Hardin	1, 824, 732	1, 480, 450	Stone, sand and gravel.
Harrison	456, 600	(2)	Do.
Henry	(2)	(2)	Do.
Howard	152, 747	141, 089	Do.
Humboldt	336, 144	243, 622	Do.
Iowa	----------	(2)	Sand and gravel.
Jackson	236, 682	131, 132	Stone, sand and gravel.
Jasper	(2)	(2)	Sand and gravel, stone.
Johnson	921, 676	734, 956	Stone, sand and gravel.
Jones	245, 713	306, 540	Do.
Keokuk	(2)	(2)	Stone, clays.
Kossuth	(2)	(2)	Sand and gravel.
Lee	570, 188	382, 454	Stone.
Linn	2, 140, 902	1, 571, 112	Stone, sand and gravel.
Louisa	(2)	(2)	Stone.
Lucas	169, 136	(2)	Coal, sand and gravel.
Lyon	99, 872	129, 040	Sand and gravel.
Madison	2, 860, 843	2, 405, 499	Stone, clays.
Mahaska	1, 131, 707	1, 035, 118	Coal, stone, clays.
Marion	2, 817, 706	2, 324, 542	Coal, stone, sand and gravel, clays.
Marshall	(2)	(2)	Sand and gravel.
Mills	(2)	(2)	Stone.
Mitchell	468, 850	419, 608	Stone, sand and gravel.
Monona	146, 250	----------	
Monroe	198, 022	141, 209	Coal.
Montgomery	(2)	(2)	Stone.
Muscatine	917, 828	1, 088, 391	Sand and gravel, stone.
O'Brien	147, 143	160, 186	Sand and gravel.
Osceola	(2)	96, 349	Do.
Palo Alto	106, 888	(2)	Do.
Plymouth	348, 533	(2)	Do.
Pocahontas	(2)	(2)	Stone.
Polk	14, 296, 416	12, 584, 488	Cement, sand and gravel, clays.
Pottawattamie	(2)	(2)	Stone.
Poweshiek	(2)	(2)	Do.
Sac	(2)	(2)	Sand and gravel.
Scott	13, 247, 437	12, 122, 061	Cement, stone, lime, clays, sand and gravel.
Shelby	34, 198	----------	
Sioux	571, 162	616, 864	Sand and gravel.
Story	(2)	685, 763	Stone, sand and gravel, clays.

See footnotes at end of table.

TABLE 6.—Value of mineral production in Iowa, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Tama	$438,974	(2)	Sand and gravel.
Taylor	(2)	(2)	Stone.
Union	------------	(2)	Do.
Van Buren	775,491	$859,512	Stone, sand and gravel, coal.
Wapello	743,987	454,504	Stone, coal, clays.
Warren	62,358	(2)	Sand and gravel, clays.
Washington	(2)	(2)	Stone.
Webster	6,295,150	5,425,286	Gypsum, stone, clays, sand and gravel.
Winnebago	72,802	(2)	Sand and gravel, peat.
Winneshiek	95,038	(2)	Sand and gravel, stone.
Woodbury	293,555	95,380	Sand and gravel.
Worth	581,906	504,564	Stone, sand and gravel, peat.
Wright	125,013	165,490	Sand and gravel.
Undistributed	13,674,532	17,247,905	
Total[3]	95,030,000	90,674,000	

[1] The following counties are not listed because no production was reported: Davis, Ida, Jefferson, Page, Ringgold, and Wayne.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Total adjusted to eliminate duplicating value of clays and stone.

masonry mix. Each company operated quarries and pits for the production of its own limestone and clay. Gypsum was purchased from Webster County operators. Mason City Brick & Tile Co. also operated a clay pit for the manufacture of building tile and draintile.

Sand and gravel and limestone were produced, chiefly for building construction and highway use.

Clayton.—A friable sandstone deposit near the town of Clayton was mined by Concrete Materials & Construction Co. Materials processed were sold chiefly for use as molding sands. This was the only friable sandstone deposit in operation in the State.

Dallas.—Adel Clay Products Co. of Redfield and Redfield Brick & Tile Co. produced miscellaneous clay for manufacture of building brick, building tile, and draintile. Sand and gravel production was reported by four companies and by the Dallas County Highway Department.

Des Moines.—United States Gypsum Co. formally opened a new gypsum mine and plant near Sperry on March 29. The depth to the gypsum formation is about 600 feet. The mine was reported to have the most modern underground equipment. Ore was transported by diesel-power haulage units from the ore face to a crusher for primary reduction, before it was hoisted by skip to the surface for storage and subsequent crushing and screening to mill size. The plant incorporated milling, calcining, mixing, board forming, and kiln equipment. Products manufactured included wallboard, sheathing, plasterbase lath, and other building products.

Sand and gravel and limestone, chiefly for road and building uses, also were produced in the county.

Dubuque.—Becker Stone Quarry of Dubuque produced dimension limestone for use as veneer and flagging. Crushed stone and sand and gravel were produced for highway use. Five companies produced limestone chiefly for road and building use, and one company and the county highway department produced sand and gravel also for building and road use. Rockford Brick & Tile Co. mined clay for the manufacture of heavy clay products.

Franklin.—Clay for heavy clay products was produced by Sheffield Brick & Tile Co. Sand and gravel was produced by four companies and the county highway department. Limestone was produced by three companies. Both limestone and sand and gravel were used chiefly in road and building construction.

Hardin.—Sand and gravel, valued at $428,000, and limestone, valued at $1,053,000, were produced in the county.

Keokuk.—Nelson Clay Products Co. of What Cheer produced fire clay chiefly for use in the manufacture of heavy clay products. Limestone for highway use was produced by Kaser Construction Co. of Des Moines.

Linn.—Sand and gravel, valued at $209,000, and limestone, valued at $1,362,000, were produced by five companies operating in the county. Output was chiefly for highway use.

Lucas.—One underground coal mine was operated by Big Ben Coal Co., and one strip mine was operated by Liberty Coal Co. Output was a little less than in 1960. Kaser Construction Co. produced a small quantity of sand and gravel.

Madison.—Some of the larger limestone quarries in Iowa were in Madison County. Chief producers were Marquette Cement Manufacturing Co., Penn-Dixie Cement Corp., E. I. Sargent Quarries, Inc., Gendler Stone Products, and Schildberg Construction Co. The two cement companies used the output from their quarries in the manufacture of portland cement. Other limestone was crushed for use in highways and as agricultural stone. Marquette Cement Manufacturing Co. also produced clay for use in the manufacture of portland cement.

Mahaska.—Coal was produced from eight strip mines by six coal companies. They were Angus Coal & Hauling Co., DeLong Coal Co., Lost Creek Coal Co., Mich Coal Co., Shinn Coal Co., and Star Coal Co. Two companies which operated in 1960 were idle in 1961; they were Lennie Coal Co., an underground mine, and the Patik Coal Co., a strip mine.

Clay for use in heavy clay products was produced by Oskaloosa Clay Products Co. and What Cheer Clay Products Co. Limestone and dolomite for highway construction were produced by Kaser Construction Co. and the Mahaska County Engineer.

Marion.—Bituminous coal was produced from 10 strip mines and 2 underground mines. Underground producers were Good Coal Co. and Lovilia Coal Co. Strip operations were by Beard Coal Co., W. H. Groenendyk, Hopkins Coal Co., Jude Coal Co., Inc., Liter Coal Co., Inc., Newton Coal Co., Valley Coal Co., VerSteeg Coal Co., Weldon Coal Co., and Wilkinson Coal Co. Two operators active in 1960 did not produce in 1961; they were W. D. Coal Co., operating an underground mine, and C. N. Knox Coal Co., operating a strip mine. One new operation was the Valley Coal Co.

Clay was produced by Goodwin Tile & Brick for heavy clay products. Sand and gravel and limestone also were produced, chiefly for highway and agricultural use.

Monroe.—Three underground bituminous coal mines and two strip mines were operated during 1961. Acme Coal Co., Cedar Valley Coal Co., and Desplanque Coal Co. operated underground mines; C. N.

Knox and Weldon Coal Co. operated strip mines. Companies not operating in 1961 were Maple Coal Co. and O'Brien Coal Co.; both companies operated underground mines in 1960. No other mineral product was reported for the county.

Polk.—Marquette Cement Manufacturing Co. and Penn-Dixie Cement Corp. operated cement plants, producing types I and II cements, and type III portland cement. Clay and limestone used in the manufacture of cement were brought in from quarries or pits in adjacent counties. Clay for the manufacture of building brick and tile was produced by Des Moines Clay Co., and Goodwin Tile & Brick Co. Sand and gravel valued at $781,000 was produced, chiefly for building and highway use. Total value for the mineral output of the county was $12,584,488.

Scott.—Mineral production of Scott County, the third ranking mineral producing county in the State, was valued at slightly over $12 million. With a plant at Davenport, Dewey Portland Cement Co., a division of Martin Marietta Corp., produced types I and II, general-use and moderate-heat cements, and type III, high-early-strength cement. Clay and limestone were produced from nearby company-owned deposits.

Linwood Stone Products Co., Inc., in a plant near Buffalo, was the State's only commercial producer of quicklime and hydrated lime. Products were sold chiefly for chemical, metallurgical, and water treatment uses.

Limestone and sand and gravel, chiefly for highway and building construction were produced by several companies.

Story.—Nevada Brick & Tile Co. produced clay for the manufacture of heavy clay products. Sand and gravel was produced by three companies, chiefly for highway use. Limestone was produced by two companies, also chiefly for highway use.

Van Buren.—Bituminous coal was produced by Laddsdale Coal Co., Inc., operating a strip mine. A considerable tonnage of crushed limestone also was produced in the county; one company, Douds Stone, Inc., at Douds, operated an underground quarry. Sand and gravel was produced chiefly for highway use.

Wapello.—Bituminous coal was produced from four strip operations. Companies operating were Airline Coal Sales Co., New Lanning Coal Co., Inc., South Iowa Coal Co., and, for the first year, VanFasson Coal Co. Aubrey Coal Co., which produced in 1960, was not active in 1961.

Clay was produced by Oskaloosa Clay Products and Ottumwa Brick & Tile Co. Products were building brick, draintile, and other heavy clay products. Limestone was produced by Wapello Stone Quarries. No sand and gravel output was reported from the county in 1961.

Warren.—Carlisle Brick & Tile Co. produced building brick, and Goodwin Tile & Brick Co. produced building brick and other heavy clay products. Sand and gravel was produced by Carlisle Sand and Gravel, Inc.

Webter.—Webster County continued to be one of the leading sources of gypsum products for the Nation. Four companies operated mines and processing facilities. They were Bestwall Gypsum Co., Celotex

Corp., National Gypsum Co., and United States Gypsum Co. All mines were open pits. Crude perlite, shipped from deposits in the Western States, was expanded by each of these companies for the manufacture of lightweight plaster aggregate.

Limestone was produced from underground mines by Ft. Dodge Limestone Co., Inc., and Northwest Limestone Co.

Building tile, draintile, and building brick were produced by Johnston Clay Works, Inc., Kalo Brick & Tile Co., Lehigh Sewer Pipe & Tile Co., and Vincent Clay Products Co.

About $139,000 worth of sand and gravel was produced by four operators, chiefly for highway and building use.

Winnebago and Worth Counties.—Eli Colby Co. and Colby Pioneer Peat Co. produced peat from bogs in these two counties. Both companies had plants at Hanlontown, where they prepared and packaged peat. Sales were in bulk and in packages.

The Mineral Industry of Kansas

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of Kansas.

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THE VALUE of commodities produced by the mineral industry of Kansas in 1961 totaled $485.9 million, an increase of more than $1.9 million over that of 1960. Mineral fuels and related products again constituted the largest part—$420.8 million, or 87 percent—of the total value.

Of 16 minerals produced in Kansas, output of 11 was larger than in 1960. Increased production was reported for all metals and most of the nonmetals. Construction-materials output was up 6 percent

TABLE 1.—Mineral production in Kansas [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland) ______ thousand 376-pound barrels__	7,877	$25,194	8,028	$25,605
Cement (masonry) ______ thousand 280-pound barrels__	382	1,179	379	1,156
Clays ______ thousand short tons__	894	1,224	954	1,225
Coal ______ do____	888	4,197	664	3,102
Helium ______ thousand cubic feet__	21,696	350	23,251	434
Lead (recoverable content of ores, etc.) ____ short tons__	781	183	1,449	298
Lime ______ thousand short tons__	______	______	15	193
Natural gas ______ million cubic feet__	634,410	74,226	649,083	81,135
Natural gas liquids:				
Natural gasoline ______ thousand gallons__	115,868	6,694	132,180	5,790
LP gases ______ do____	127,270	6,343	135,643	5,916
Petroleum (crude) ______ thousand 42-gallon barrels__	113,453	329,014	[2] 112,241	[2] 324,376
Salt ______ thousand short tons__	1,213	14,109	[3] 913	[3] 11,409
Sand and gravel ______ do____	9,710	6,808	11,366	7,781
Stone [4] ______ do____	11,814	15,031	12,828	16,411
Zinc (recoverable content of ores, etc.) ____ short tons__	2,117	546	2,446	568
Value of items that cannot be disclosed: Natural cement, gem stones (1960), gypsum, pumice, salt (brine 1961), stone (crushed sandstone) ______	______	1,436	______	3,204
Total Kansas [5] ______	______	[6] 483,952	______	485,872

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Preliminary figure.
[3] Excludes salt in brine included with "Value of items that cannot be disclosed."
[4] Excludes certain stone included with "Value of items that cannot be disclosed."
[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.
[6] Revised figure.

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[1] Mining engineer, Bureau of Mines, Bartlesville, Okla.
[2] Petroleum engineer, Bureau of Mines, Bartlesville, Okla.
[3] Geologist, State Geological Survey of Kansas, University of Kansas, Lawrence, Kans.

owing to increased requirements for defense installations, highways, and reservoirs. Salt production declined because of domestic competition for markets. Output of mineral fuels approximated that of 1960.

The five principal minerals, in order of value, were petroleum, natural gas, cement, stone, and salt.

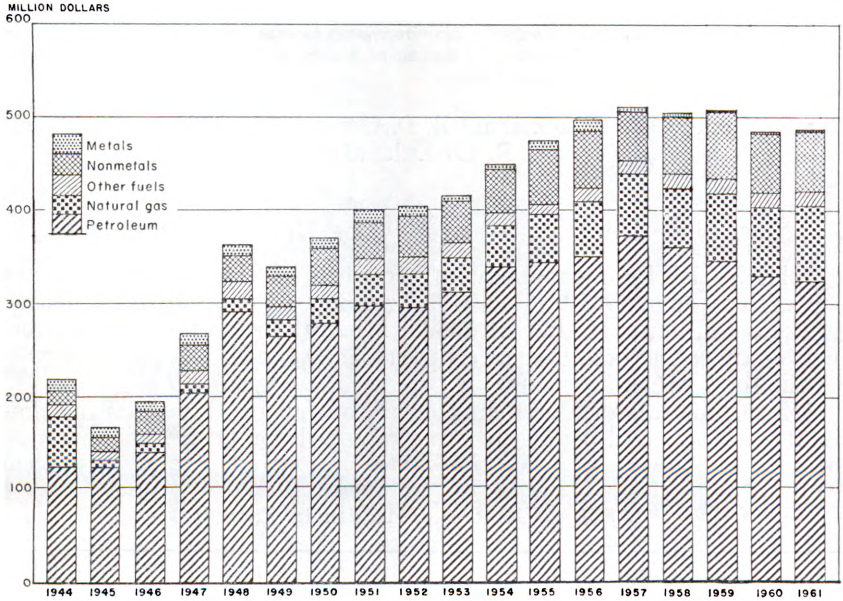

FIGURE 1.—Value of mineral production in Kansas 1944–61.

The population of Kansas at yearend was reported by the U. S. Bureau of the Census as 2,146,154, an increase of 15,575 residents since 1950. Johnson, Sedgwick, Shawnee, and Wyandotte were the largest counties and contained approximately 38 percent of the State population. The census data disclosed a vast increase in urbanization during the last decade. Results of the 1960 census showed that 72 percent of the population of Kansas lived in cities, compared with 65 percent in 1950. The increase in population was reflected in a rise in consumption of mineral fuels and construction materials produced in the State.

Employment and Injuries.—The economic recovery predicted for 1961 did not materialize; employment failed to return to the prerecession level of 1959. Labor statistics of the Employment Security Division, Kansas Department of Labor, reported decreased employment in the mineral industry. Analysis of the statistics revealed that wages were higher in oil refining than in the mining industry. Oil refinery workers average weekly income was $120.48 compared with $103.12 and $102.89 for mining and crude petroleum, respectively.

The Workman's Compensation Commission, State of Kansas, reported that 827 on-the-job injuries occurred in the mineral industry during 1961. Six of the injuries were fatal.

TABLE 2.—Average annual employment for selected mineral industries

Industry	1952–56 (average)	1957	1958	1959	1960	1961
Mining (total)	18,820	18,500	18,200	18,300	16,900	16,200
Metal mining	420	300	100	(1)	(1)	(1)
Mining and quarrying of nonmetallic metals, except fuels	1,760	1,800	1,800	1,900	1,700	1,600
Bituminous coal and lignite mining	500	400	300	300	300	300
Crude petroleum and natural gas	16,140	16,000	16,000	16,100	14,900	14,300
Petroleum refining and related industries	5,080	4,900	4,800	4,900	4,700	4,600

[1] Employment estimated to be less than 100.

Source: Employment Security Division, Kansas Department of Labor.

Legislation and Government Programs.—Assessed valuation of oil operating property was $310 million, a decline of 3 percent from 1960. A special evaluation committee was appointed by the State Legislature to prepare a statewide schedule for assessing oil producing equipment and active oil wells.

The Federal Congress, in October, approved legislation, which became Public Law 87–347, authorizing stabilization payments to small lead and zinc producers, but no funds had been appropriated by yearend.

The Federal Supreme Court reversed an earlier Kansas court decision to levy personal property tax on oil and gas leases held by Federal Land Banks.

The Kansas State Highway Commission announced that construction expenditures for roads in 1961 were $63.8 million, an increase of $8.1 million over 1960. A total of 171 miles of Interstate Systems highway was opened to traffic during the year; another 50 miles was under construction.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Modest increases of output were reported for 1961 for some of the mineral fuels produced in Kansas. The decrease in crude petroleum production was due to competition for markets from natural gas and imports. Fewer coal mines were active during the year; those that were operating had curtailed production.

Carbon Black.—Quantity and value of carbon black increased 3 and 11 percent, respectively. The material was processed in furnace-type plants of Columbian Carbon Co. at Hickok and United Carbon Co.

TABLE 3.—Carbon black production

	1958	1959	1960	1961
Carbon black produced, all grades ... pounds	75,443,750	91,644,160	87,302,185	89,936,075
Value at plants	$5,271,143	$6,387,598	$5,621,236	$6,243,192
Natural gas processed ... thousand cubic feet	3,262,970	4,624,404	3,914,444	3,645,118
LP gases and other liquid fuel processed ... barrels	[1] 356,512	390,063	398,415	361,005

[1] Revised figure.

Source: Kansas Corporation Commission.

at Ryus in Grant County. Both plants used LP gases and natural gas as feed.

Coal (Bituminous).—Output of bituminous coal decreased in volume and value by more than 25 percent as compared with 1960. Production of ten mines reported was above 1,000 tons; all except one were open pit mines. A total of 663,758 tons was mined in five counties—Bourbon, Cherokee, Coffey, Crawford, and Osage. Four other active mines in Linn and Osage Counties had an annual production of less than 1,000 tons each.

TABLE 4.—Coal (bituminous) production

(Excludes mines producing less than 1,000 short tons)

Year	Number of mines			Short tons (thousands)	Value (thousands)
	Underground	Strip	Total		
1952–56 (average)				1,348	$5,526
1957	3	14	17	749	3,331
1958	2	13	15	823	3,711
1959	2	11	13	772	3,607
1960	2	11	13	888	4,197
1961	1	9	10	664	3,102

Average price per ton of coal in 1961 was $4.67. Total value of coal production amounted to $3.1 million or $1.1 million less than in 1960. The Kansas coal industry produced custom coal which was utilized as standby fuel during prolonged cold-weather periods by the utilities and other industries. The winter of 1961 was comparatively mild, consequently, the coal market declined.

Proved coal reserves in Kansas at yearend were estimated at about 1.1 billion tons,[4] of which approximately 835 million tons or about 75 percent was judged to be recoverable coal.

Helium.—Shipments from the Federal Bureau of Mines Otis helium plant in Rush County were 7 percent above the 1960 shipments. Helium was extracted from natural gas from Behrens, Otis-Albert, Pawnee, Rock, Reichel, Ryan, and Unruh fields in Barton, Pawnee, and Rush Counties. Value of production totaled nearly $434,000, a 24-percent increase over 1960.

Increased use of helium by the computer industry as a heat-transfer medium, by the U.S. Atomic Energy Commission, and for rocketry applications created a larger demand for the commodity. Construction of three new helium extracting plants, in Ellsworth, Grant, and Seward Counties, was authorized in 1961 by the Department of the Interior. The plants would increase helium recovery by more than 2 billion cubic feet a year.

Natural Gas.—Marketed production of natural gas increased 2 percent in volume and 9 percent in value over that in 1960. Twelve new gasfields and 31 new gas pools were discovered. Natural gas was produced in 47 counties. Kansas ranked fifth for the second consecutive year in marketed gas production. Hugoton gasfield, the World's largest, is in southwest Kansas and the panhandles of Oklahoma and Texas. The Kansas portion of the field contributed 72 percent of the total natural gas output of the State. Late in 1961, Pan American Petroleum Co. constructed a 50-mile gathering pipeline to utilize gas from new pools near the Hugoton area. New natural gas facilities valued at $12 million were in various stages of construction during the year. Mobil Oil Co. and Panhandle Eastern Pipeline Co. completed natural gas pumping stations in Hickok and Hugoton. The first uninterruptable industrial gas pipeline in the State was constructed by Anadarko Production Co., subsidiary of Panhandle Eastern Pipeline Co., from the Spivey-Grabs-Basil gasfield in Harper

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[4] Schoewe, W. H. The Mineral Industry of Kansas in 1960. State Geol. Survey, Bull. 152, pt. 3.

TABLE 5.—Marketed production of natural gas

Year	Million cubic feet	Value (thousands)	Year	Million cubic feet	Value (thousands)
1952–56 (average)	448,530	$45,172	1959	604,410	$72,529
1957	586,690	66,883	1960	634,410	74,226
1958	561,816	64,047	1961	649,083	81,135

TABLE 6.—Marketed production of natural gas from the Kansas part of Hugoton gas area

Year	Million cubic feet	Year	Million cubic feet
1942	46,365	1952	375,082
1943	70,922	1953	387,635
1944	92,923	1954	346,732
1945	90,345	1955	394,257
1946	119,638	1956	381,875
1947	157,663	1957	396,889
1948	185,873	1958	349,264
1949	247,869	1959	404,764
1950	320,545	1960	451,820
1951	371,002	1961	467,842

Source: 1942–57 data from Oil and Gas Developments in Kansas During 1957: State Geol. Survey of Kansas, Univ. of Kansas Pub. Bull. 133, 1958, p. 33. 1958–61 data from Conservation Division, Kansas Corporation Commission.

TABLE 7.—Important new gasfields discovered in 1961

(Thousand cubic feet per day)

Pool or field	County	Initial production
Shimer	Comanche	2,500
Grant (Mississippian)	Harper	9,000
Lemon North (Des Moines)	Haskell	8,400
Lemon Northwest (Morrow)	do	1,900
Negro Creek	Kingman	5,300
Fralick West	Kiowa	4,333
Ursula	do	3,000
Stenzel	Marion	2,200
Richfield West	Morton	2,220
Wilburton South	do	22,500
Sawyer	Pratt	6,978
Hugoton North	Scott	7,536
Blue Bell Northwest (Morrow)	Seward	8,300
Kismet	do	13,200
Nich	Stanton	9,236
Cutter (Chester)	Stevens	1,448
Ski	do	2,150

Source: State Geol. Survey of Kansas, Oil and Gas Developments in Kansas During 1961. Bull. 160 (advance).

and Kingman Counties to the Skelly Oil Co. El Dorado refinery. The State's largest underground gas storage facility (Cities Service Gas Co., Elk City field of Elk and Montgomery Counties) doubled its working gas capacity to 10 billion cubic feet. Cities Service Gas Co. constructed the State's second largest underground storage facility in Alden field of Rice County with 5 billion cubic feet working capacity. At yearend, there were 15 underground storage projects totaling over 41 billion cubic feet working capacity, about the same as in 1960.[5]

TABLE 8.—Leading gasfields[1]

(Million cubic feet)

Field	County	Discovery date	Annual production			Cumulative production
			1959	1960	1961	Dec. 31, 1961
Hugoton Gas Area	(2)	1930	404,764	451,820	467,842	5,934,144
Greenwood Gas Area	Morton	1951	53,278	38,695	39,771	314,507
Medicine Lodge-Boggs	Barber	1927	10,854	6,677	5,058	262,280
Spivey-Grabs-Basil	Harper-Kingman	1949	14,854	19,329	24,953	96,234
Hardtner	Barber	1954	9,302	7,811	6,340	64,796
Rhodes	do	1954	11,778	11,560	9,832	64,441
McKinney	Clark-Meade	1950	6,762	6,888	7,804	45,843
Boggs Southwest	Barber	1955	4,183	4,856	3,207	40,359
Sparks	Morton-Stanton	1954	6,190	5,952	6,360	31,052

[1] Fields with cumulative production in excess of 30 billion cubic feet.

[2] Stevens, Grant, Kearny, Finney, Haskell, Morton, Seward, Stanton, and Hamilton Counties (in descending order of cumulative production).

Source: State Geol. Survey of Kansas, Oil and Gas Developments in Kansas During 1961. Bull. 160 (advance).

Natural Gas Liquids.—Recovery of natural gas liquids at 14 gasoline plants increased 10 percent in volume but decreased 10 percent in value compared with 1960. The loss in production value was due to a price drop of 1 cent per gallon. Of the total output, LP gases comprised 51 percent and natural gasoline production constituted the remaining 49 percent.

TABLE 9.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	113,747	$6,340	86,599	$3,046	200,346	$9,386
1957	119,247	6,569	103,494	4,042	222,741	10,611
1958	110,293	6,229	115,175	5,193	225.468	11,422
1959	107,814	5,576	124,874	6,658	232,688	12,234
1960	115,868	6,694	127,270	6,343	243,138	13,037
1961	132,180	5,790	135,643	5,916	267,823	11,706

Overproduction of LP gases, in part due to a leveling off in petrochemical expansion, resulted in an oversupply of these liquids and general weakening of the price structure. The oversupply of gasoline instituted price wars throughout the United States and lowered financial returns to industry.

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[5] Oil and Gas Journal, v. 60, No. 20, May 14, 1962, p. 127.

TABLE 10.—Natural gasoline and LP gases produced in 1961

(Barrels)

Company	Location		Natural gasoline	Butane	Propane	LP gases	Total
	Nearest town	County					
Cities Service Petroleum Co.	Wichita	Sedgwick	325,855	383,153	335,774	---------	1,044,782
Colorado Interstate Gas Co.	Lakin	Kearny	88,137	---------	---------	---------	88,137
Hugoton Production Co	Ulysses	Grant	143,085	164,810	159,959	---------	467,854
Kansas Hydrocarbon Co	Cheney	Sedgwick	62,059	19,075	52,005	---------	133,139
Kansas-Nebraska Natural Gas Co.	Deerfield	Kearny	139,418	---------	27,697	21,458	188,573
Northern Natural Gas Co	Holcomb	Finney	110,257	---------	---------	---------	110,257
Do	Sublette	Haskell	343,657	---------	---------	---------	343,657
Pan American Petroleum Corp.	Ulysses	Grant	524,529	613,057	399,568	130,201	1,667,355
Panhandle Eastern Pipe Line Co.	Liberal	Seward	514,274	253,912	147,886	---------	916,072
Skelly Oil Co	Medicine Lodge.	Barber	91,999	---------	85,450	---------	177,449
Do	Minneola	Clark	82,505	---------	55,465	---------	137,970
Socony Mobil Oil Co., Inc	Ulysses	Grant	220,800	55,744	97,257	---------	373,801
Do	Spivey	Kingman	211,404	103,196	186,440	---------	501,040

Source: Kansas Corporation Commission.

A new plant was placed onstream by Skelly Oil Co. at Minneola in Clark County. The Cities Service Petroleum Co. Burrton plant in Reno County was closed. Rounds & Stewart's natural gasoline plant was under construction in the Lost Springs Field in Marion County.

Underground storage capacity in October for 18 separate salt-cavern projects in Ellsworth, Kingman, McPherson, and Reno Counties totaled 7.4 million barrels.[6] This was an increase of seven new projects during the year, and a storage capacity increase of about 139 percent over the 3 million barrel storage capacity in November 1960.

Petroleum.—Kansas ranked sixth among the oil-producing States. Crude oil production was 112.2 million barrels, or 1.2 million barrels less than in 1960. The Kansas Corporation Commission reduced allowables in May in order to balance production with demand. At yearend, crude petroleum in storage was over 8 million barrels. The price of crude petroleum was $2.89 per barrel, 1 cent less than in 1960.

TABLE 11.—Crude petroleum production

(Thousand barrels and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952-56 (average)	118,913	$324,914	1959	119,543	347,870
1957	123,614	372,078	1960	113,453	329,014
1958	119,942	359,826	1961 [1]	112,241	324,376

[1] Preliminary figures.

Eighty counties reported petroleum production, 1 more than in 1960. Oil was produced from about 46,000 wells; the average production of each well was 6.6 barrels per day. Of the total oil produced 18 percent (20.2 million barrels) was obtained by secondary

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[6] Oil and Gas Journal, v. 59, No. 42, Oct. 16, 1961, p. 88.

TABLE 12.—Crude petroleum production, indicated demand, and stocks in 1961, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks originating in Kansas (end of month)	Month	Production	Indicated demand	Stocks originating in Kansas (end of month)
January	9,620	10,078	8,940	September	9,137	9,573	8,279
February	8,887	8,433	9,394	October	9,551	8,198	9,632
March	9,697	9,128	9,963	November	9,232	9,501	9,363
April	9,276	8,997	10,242	December	9,153	10,104	8,412
May	9,538	9,301	10,479				
June	9,237	9,116	10,600	Total: 1961[1]	112,241	113,227	----------
July	9,287	10,175	9,712	1960	113,453	113,783	----------
August	9,626	10,623	8,715				

[1] Preliminary figures.

recovery methods, an increase of 0.9 million barrels over the 1960 figure. At yearend, the State had produced a cumulative total of about 3.4 billion barrels of crude oil valued at over $7 billion; the Arbuckle dolomite of Cambro-Ordovician age accounted for 45 percent of the production.

The Interstate Oil Compact Commission, in cooperation with the Independent Petroleum Association of America and the National Stripper Well Association, reported that on January 1, 1961, Kansas had 40,524 stripper wells, which produced over 75 million barrels of oil in 1960. Oil reserves of these wells totaled over 548 million barrels.

Drilling and Exploration.—A total of 3,335 wells was recorded as drilled in Kansas, a decrease of 201 wells or 5.7 percent from 1960.[7] Of the wells recorded, 1,315 produced oil, 221 gas, 87 oil and gas; 1,485

TABLE 13.—Pipeline runs of crude petroleum, by fields[1]

(Thousand barrels)

Field[2]	1957	1958	1959	1960	1961
Bemis-Shutts	5,922	5,063	4,868	4,472	4,116
Chase-Silica	4,271	3,260	3,689	3,219	2,919
El Dorado	4,619	4,371	4,443	4,291	4,239
Geneseo-Edwards	2,236	1,812	1,680	1,565	1,529
Gorham	1,501	1,499	1,421	1,311	1,238
Hall-Gurney	3,543	3,296	3,253	3,229	3,291
Kraft-Prusa	3,437	3,092	2,890	2,526	2,317
Lost Springs	550	495	1,704	1,914	2,350
Marcotte	2,020	1,779	1,596	1,424	1,258
Morel	1,617	1,477	1,354	1,299	1,239
Pleasant Prairie	92	254	1,369	1,839	1,719
Ray	1,314	1,353	1,363	1,289	1,306
Ritz-Canton	1,563	1,542	1,321	1,199	1,120
Spivey-Grabs-Basil	2,031	1,961	2,370	2,492	3,726
Trapp	3,728	3,366	3,120	2,752	2,542
Trico	1,239	1,253	1,117	991	1,146
Other fields[3]	84,371	84,069	81,945	77,532	76,156
Total	124,054	119,942	119,503	113,344	112,211
Change in field stocks[3]	----------	----------	+40	+109	+30
Total production[3]	123,614	119,942	119,543	113,453	[4] 112,241

[1] Fields with current annual pipeline runs in excess of 1 million barrels.
[2] Breakdown for individual fields from Kansas Geol. Survey.
[3] Bureau of Mines figures.
[4] Preliminary figure.

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[7] Goebel, E. D., and others. State Geol. Survey of Kansas, 1962, Bull. 160 (advance).

TABLE 14.—Important new oilfields discovered in 1961

(Barrels per day)

Field	County	Initial production
Erna	Barton	108
Ferrell South	Butler	76
Bolack	Cowley	65
Amazon Ditch	Finney	336
Cowgill	do	120
Nunn East	do	100
Little Coon Creek	Ford	25
Da Vatz	Grant	144
Ryus	do	190
Rex	Harper	166
Sullivan	do	62
Lemon Northwest	Haskell	159
Hanston	Hodgeman	188
Pendennis	Lane	42
Arnold Southwest	Ness	109
Brehm	Pratt	205
Tobias	Rice	108
Schwindt	Rush	77
Gillian	Sedgwick	165
Ang	Seward	95
Cutter	Stevens	71

Source: State Geol. Survey of Kansas, Oil and Gas Developments in Kansas During 1961. Bull. 160 (advance).

TABLE 15.—Leading oilfields[1]

(Thousand barrels)

Field	County	Discovery date	Annual production			Cumulative production		
			1959	1960	1961	Dec. 31, 1959	Dec. 31, 1960	Dec. 31, 1961
El Dorado	Butler	1915	4,443	4,291	4,239	241,183	245,474	249,713
Chase-Silica	Barton Rice Stafford	1931	3,689	3,219	2,919	215,317	218,536	221,451
Bemis-Shutts	Ellis Rooks	1935	4,868	4,472	4,116	171,508	175,980	180,096
Trapp	Barton Russell	1936	3,120	2,752	2,542	164,461	167,213	169,755

[1] Fields with cumulative production in excess of 100 million barrels.

Source: State Geol. Survey of Kansas, Oil and Gas Developments in Kansas During 1961. Bull. 160 (advance).

were dry and abandoned; 227 were service wells. In addition to the wells recorded as completed, an estimated 904 wells were drilled in eastern Kansas, based on permits on file with the Kansas Corporation Commission. The year's drilling activity was chiefly due to increased development of the southwestern and central counties. Revived interest in pre-Permian exploration resulted in the gas play in the Hugoton Embayment. Completions in the Arbuckle dolomite in other parts of the State were significant. Exploratory work to find other Arbuckle production continued throughout the year and about 100 additional wells were drilled to test Precambrian rocks just below the Arbuckle dolomite; about 2,200 wells had penetrated this basement complex.[8]

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[8] Cole, Virgil B., Daniel F. Merriam, and others. Wells Drilled Into Precambrian Rock in Kansas. State Geol. Survey of Kansas, Bull. 150, 1961.
Cole, Virgil B., and Daniel F. Merriam. Progress Report of the Kansas Basement Rocks Committee and Additional Precambrian Well. State Geol. Survey of Kansas, Bull. 157, pt. 2, 1962.

TABLE 16.—Oil and gas well drilling in 1961

County	Wells drilled					Unclassified [1]	Total
	Oil	Gas	Oil and gas	Service	Dry		
Allen	28	----------	----------	11	----------	186	225
Anderson	1	----------	----------	12	----------	22	35
Barber	4	13	11	1	27	----------	56
Barton	72	2	1	4	100	----------	179
Bourbon	----------	----------	----------	28	----------	42	70
Butler	123	----------	----------	42	79	----------	244
Chase	8	----------	----------	----------	6	----------	14
Chautauqua	6	----------	----------	5	8	41	60
Cheyenne	----------	----------	----------	----------	1	----------	1
Clark	1	11	6	----------	19	----------	37
Cloud	----------	----------	----------	----------	1	----------	1
Coffey	----------	----------	----------	----------	3	7	10
Comanche	----------	2	2	----------	2	----------	6
Cowley	48	1	1	5	67	----------	122
Crawford	----------	----------	----------	----------	----------	35	35
Decatur	8	----------	----------	1	23	----------	32
Dickinson	----------	----------	----------	1	5	----------	6
Douglas	----------	----------	----------	----------	1	14	15
Edwards	2	1	4	----------	3	----------	10
Elk	----------	4	----------	----------	3	8	15
Ellis	82	----------	----------	7	81	----------	170
Ellsworth	3	----------	----------	----------	12	----------	15
Finney	16	36	----------	1	16	----------	69
Ford	2	----------	----------	----------	18	----------	20
Franklin	----------	----------	----------	----------	----------	30	30
Geary	----------	----------	----------	----------	3	----------	3
Gove	3	----------	----------	----------	1	----------	4
Graham	48	----------	----------	----------	37	----------	85
Grant	2	5	----------	----------	3	----------	10
Gray	----------	----------	----------	----------	1	----------	1
Greeley	----------	----------	----------	----------	8	----------	8
Greenwood	85	1	----------	27	53	----------	166
Hamilton	----------	5	----------	----------	11	----------	16
Harper	7	2	6	1	17	----------	33
Harvey	14	4	----------	----------	10	----------	28
Haskell	11	11	8	1	16	----------	47
Hodgeman	12	----------	----------	3	27	----------	42
Jackson	----------	----------	----------	----------	1	----------	1
Jefferson	----------	----------	----------	----------	1	----------	1
Johnson	----------	----------	----------	----------	----------	28	28
Kearny	----------	1	----------	----------	9	----------	10
Kingman	38	3	11	3	41	----------	96
Kiowa	2	2	4	----------	11	----------	19
Labette	----------	----------	----------	1	2	27	30
Lane	2	----------	----------	----------	7	----------	9
Leavenworth	----------	----------	----------	----------	1	----------	1
Lincoln	----------	----------	----------	----------	1	----------	1
Linn	5	----------	----------	----------	----------	13	18
Logan	----------	----------	----------	----------	4	----------	4
Lyon	1	----------	----------	----------	6	----------	7
McPherson	48	----------	----------	2	33	----------	83
Marion	132	21	5	7	76	----------	241
Marshall	----------	----------	----------	----------	2	----------	2
Meade	----------	11	----------	----------	15	----------	26
Miami	6	----------	----------	----------	----------	84	90
Mitchell	----------	----------	----------	----------	2	----------	2
Montgomery	1	----------	----------	----------	----------	69	70
Morris	----------	----------	----------	1	7	----------	8
Morton	17	30	1	----------	21	----------	69
Nemaha	----------	----------	----------	----------	1	----------	1
Neosho	1	----------	----------	16	----------	93	110
Ness	12	----------	----------	----------	24	----------	36
Norton	2	----------	----------	----------	16	----------	18
Osborne	----------	----------	----------	----------	1	----------	1
Osage	----------	----------	----------	----------	9	----------	9
Pawnee	5	----------	----------	----------	12	----------	17
Phillips	21	----------	----------	4	4	----------	29
Pottawatomie	----------	----------	----------	----------	3	----------	3
Pratt	5	11	2	----------	30	----------	48
Rawlins	2	----------	----------	----------	33	----------	35
Reno	13	----------	----------	----------	18	----------	31
Rice	66	2	1	3	50	----------	122
Riley	5	----------	----------	----------	3	----------	8
Rooks	31	----------	----------	----------	26	----------	57
Rush	10	6	----------	11	16	----------	43
Russell	68	1	1	6	31	----------	107
Saline	49	----------	----------	1	16	----------	66

See footnote at end of table.

TABLE 16.—Oil and gas will drilling in 1961—Continued

County	Wells drilled					Unclassified [1]	Total
	Oil	Gas	Oil and gas	Service	Dry		
Scott	2	2			8		12
Sedgwick	23			3	35		61
Seward	17	7	8		9		41
Sheridan					4		4
Sherman					2		2
Stafford	103	8	9	1	113		234
Stanton		11			16		27
Stevens	2	6	5		3		16
Sumner	21	1	1	1	77		101
Thomas					9		9
Trego	12				13		25
Wabaunsee					4		4
Wallace					2		2
Wilson	5			15		110	130
Woodson	2			2		95	99
Total: 1961	1,315	221	87	227	1,485	904	4,239
1960	1,556	159	68	181	1,562	953	4,479

[1] Estimate.

Source: State Geol. Survey of Kansas, Oil and Gas Developments in Kansas during 1961: Bull. 160 (advance).

Marketing Developments.—In October, the Kansas Corporation Commission increased allowables per well in the Hugoton Gas Area. Research in conservation and production was the basis for the decision. This decision assured Kansas producers of a larger share of the natural gas market and resulted in an increase in revenue of $17.6 million in 1961.

TABLE 17.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Product	Proved reserves, Dec. 31, 1960	Changes in proved reserves, due to extensions and new discoveries in 1961	Proved reserves, Dec. 31, 1961 (production was deducted)	Changes from 1960, percent
Crude oil thousand barrels	883,849	106,547	878,027	−1
Natural gas liquids [1] do	198,403	−8,132	183,579	−7
Natural gas million cubic feet	19,620,224	268,293	19,190,005	−2

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas. v. 16, Dec. 31, 1961, pp. 11. 12, and 21.

Congress authorized the U.S. Department of the Interior to negotiate with private industry for purchase of $47.5 million worth of helium annually for a 20-year period. At yearend, helium production valued at $33.8 million annually was contracted with Cities Service Helex, Inc., Helex Co. (Northern Natural Gas), and National Helium Corp. (Panhandle Eastern Pipeline and National Distillers). The three Kansas helium plants to be built by industry were estimated to involve a capital outlay of about $63 million.

The Bureau of Mines, in November, increased the price of helium from $19 to $35 per thousand cubic feet, the first price increase since 1954. Retail prices, which were not controlled by the Federal Government, ranged from $60 to $110 per thousand cubic feet, depending on quantity, method of shipment, distribution, and transportation.

Pipeline and Transportation.—Pipelines transported vast quantities of oil, natural gas, and natural gas liquids in and out of Kansas and were an important part of the petroleum industry. Construction of new pipelines and movement of hydrocarbons across the State line were regulated by the Kansas Corporation Commission, the Interstate Commerce Commission, and the Federal Power Commission.

About 169 miles of multiproduct transmission lines were in various stages of construction in Kansas in 1961, by Pan American, Panhandle Eastern, and Shamrock pipeline companies. Kaneb Pipeline Co. was constructing a multiproduct terminal to be utilized in conjunction with its transmission system near Miltonvale. Sinclair Pipeline Co. purchased from Wheat-Belt Pipeline Co. its gathering systems serving crude and condensate producers in the Harper Ranch area.

NONMETALS

Production value of eight nonmetals contributed $64 million to the economy of Kansas, in 1961, or 13 percent of the total mineral production value. The more important nonmetal commodities, in order of value, were cement, stone, and salt. Production increases were reported for all nonmetals except salt. Lime was produced for the first time in many years. Almost all nonmetals were produced for local markets, principally because of their bulk weight and low unit value.

Cement.—Shipments of portland cement were 2 percent greater in quantity and value than in 1960. The average price of portland cement was $3.19 per barrel, 1 cent less than in 1960.

The volume and value of masonry cement produced approximated that of 1960, but the average price was 4 cents lower per barrel. Masonry and portland cements were produced in five counties—Allen, Montgomery, Neosho, Wilson, and Wyandotte. In Bourbon County, Ft. Scott Hydraulic Cement Co. produced natural cement.

TABLE 18.—Portland cement production and shipments

(Thousand barrels and thousand dollars)

Year	Production	Shipments		Year	Production	Shipments	
		Quantity	Value			Quantity	Value
1952-56 (average)	9,190	9,149	$24,030	1959	10,177	10,056	$30,889
1957	8,118	7,864	23,593	1960	7,996	7,877	25,194
1958	9,244	9,298	28,843	1961	8,329	8,028	25,605

TABLE 19.—Shipments of portland cement to Kansas consumers

Year	Kansas (thousand barrels)	Change, percent		Year	Kansas (thousand barrels)	Change, percent	
		In Kansas	In United States			In Kansas	In United States
1952-56 (average)	6,490			1959	6,889	+8	+9
1957	4,981	−23	−6	1960	5,070	−26	−7
1958	6,397	+28	+6	1961	5,770	+14	+3

The cement industry operated at approximately 64 percent of capacity, thus keeping production at about the same level as market requirements. About 67 percent of the cement was produced by the wet process and 33 percent by the dry process. Intrastate markets consumed 62 percent of the cement shipped; the remainder went to Arkansas, Illinois, Iowa, Missouri, Nebraska, Oklahoma, Texas, and California.

Clays.—Total output of clay and shale, valued at $1.2 million, was 7 percent more than in 1960. The cement industry consumed 42 percent of the clay and shale produced.

TABLE 20.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	788	$942	1959	1,021	$1,271
1957	909	1,240	1960	894	1,224
1958	875	1,145	1961	954	1,225

Clay was mined in Barton, Cherokee, Cloud, Crawford, and Ellsworth Counties and was used in manufacturing building brick, drain tile, and sewer pipe. The heavy clay products industry used 24 percent of the total clay production.

The value of shale utilized for miscellaneous purposes approximated that of 1960. Part of the shale was bloated and processed for lightweight aggregate.

Reserves of clay and shale in Kansas are virtually unlimited, but the most valuable clays or shales are in the central and northcentral parts of the State. Two publications summarizing research on Kansas clays were released.[9]

Gypsum.—Output of crude gypsum increased 8 percent in quantity and 11 percent in value over the 1960 figures. Gypsum was mined underground in two counties—Barber and Marshall. Late in 1960, Bestwall Gypsum Co. completed relocation of its plant, and shipment of finished wallboard began early in 1961. The facilities previously occupied became inaccessible owing to construction of Tuttle Creek Reservoir.

Output of calcined gypsum was 4 percent more than in 1960. Gypsum production closely paralleled the building industry, and the increased output resulted from a general rise in building construction.

Lime.—For the first time in many years, quicklime was produced in Kansas by Midwest Lime Co. in Leavenworth County. A high calcium limestone member of the Wyandotte formation was mined by Loring Quarries and trucked to the Midwest plant. The entire output was shipped to the Kansas City Water Department of Kansas City, Mo., for use in water purification.

Pumice.—Pumicite (volcanic ash) was mined and prepared in Lincoln and Norton Counties. The product was utilized as an abrasive in scouring compounds, and as floor cleaning material.

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[9] Plummer, M. P., M. R. Bauleke, W. B. Hladik. Dakota Formation Refractory Clays and Silts in Kansas. State Geol. Survey of Kansas, Bull. 142, pt. 1, 1961, 52 pp.
Hattin, D. E. Stratigraphy of the Carlisle Shale in Kansas. State Geol. Survey of Kansas, Bull. 156, 1962, 155 pp.

Pumicite or volcanic ash is extensively distributed over the western half of the State. Although production increased in 1961, a research program was instituted in an effort to expand and diversify the markets. A publication describing new uses for volcanic ash was released.[10]

Salt.—Output of evaporated and rock salt did not attain the production level of 1960. High transportation costs to Midwestern markets and a decrease in salt requirements by the meat packing industry were responsible for the drop in production.

TABLE 21.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	382	$5,542	540	$2,400	922	$7,942
1957	522	7,785	496	2,568	1,018	10,353
1958	373	7,962	[1] 700	[1] 3,386	1,073	11,348
1959	389	9,035	[1] 734	[1] 4,635	1,123	13,670
1960	402	9,358	[1] 811	[1] 4,751	1,213	14,109
1961	411	9,180	502	2,229	[2] 913	[2] 11,409

[1] Brine included with rock salt (previously included with evaporated salt) to avoid disclosing individual company confidential data.

[2] Excludes brine.

Commercial salt was produced by seven companies; one produced rock salt, four produced evaporated salt, and two produced both rock and evaporated salt. Of the salt produced, 410,674 tons, or 45 percent, was evaporated salt and 502,476 tons, or 55 percent, was rock salt. Though output decreased in 1961, salt again ranked fifth in value among mineral commodities produced in the State. A publication was released describing salt flowage.[11]

Frontier Chemical Co. recovered salt from brine wells in Sedgwick County for use in manufacturing industrial chemicals and other uses.

Sand and Gravel.—Total sand and gravel production increased 17 percent in volume and 14 percent in value over 1960. Sand and gravel was produced in 71 counties, chiefly from riverbed deposits. Almost all production was used locally for paving and building.

TABLE 22.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	8,295	$5,952	1,847	$612	10,142	$6,564
1957	7,680	5,425	1,665	750	9,345	6,175
1958	8,282	5,806	2,035	963	10,317	6,769
1959	9,257	6,661	2,077	1,276	11,334	7,937
1960	8,178	6,148	1,532	660	9,710	6,808
1961	8,975	6,722	2,391	1,059	11,366	7,781

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[10] Bauleke, M. P. What's New in Volcanic Ash for Industry? State Geol. Survey of Kansas, Bull. 157, pt. 3, 22 pp.

[11] Snyder, J.D., and L. F. Dellwig. Plastic Flowage of Salt in Mines at Hutchinson and Lyons, Kansas. State Geol. Survey of Kansas, Bull. 152, pt. 2, 1961, 46 pp.

TABLE 23.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,136	$2,390	3,224	$2,364
Paving	2,801	1,985	3,466	2,695
Fill	559	259	682	378
Other [1]	92	109	177	142
Total sand	6,588	4,743	7,549	5,579
Gravel:				
Building	234	228	155	129
Paving	1,276	1,087	1,192	932
Fill	29	24	25	16
Other [2]	51	66	54	66
Total gravel	1,590	1,405	1,426	1,143
Total sand and gravel	8,178	6,148	8,975	6,722
Government-and-contractor operations:				
Sand:				
Paving	820	426	1,342	600
Gravel:				
Building	12	4	43	16
Paving	585	189	993	438
Fill	39	17	13	5
Other	76	24	----------	----------
Total gravel	712	234	1,049	459
Total sand and gravel	1,532	660	2,391	1,059
Grand total	9,710	6,808	11,366	7,781

[1] Includes glass, molding, filtering, and other construction and industrial sand.
[2] Includes railroad ballast and miscellaneous gravel.

Commercially produced sand and gravel comprised 79 percent of the total output; Government-and-contractor production accounted for the remaining 21 percent. A significant increase in production of Government-and-contractor sand and gravel was due to defense, highway, and reservoir construction in the State.

Stone.—Stone production increased 4 percent in volume and 9 percent in value over 1960. Limestone, sandstone, and miscellaneous stone or chats were produced from quarries in 47 counties.

Limestone comprised 95 percent of the total stone produced. It was used principally for concrete aggregate, roadstone, cement, but large quantities also were used as agricultural stone, riprap, and building stone. The cement industry consumed over 2 million tons valued at $2.3 million, or 18 percent of the output of limestone.

Sandstone was produced mainly in Lincoln County; smaller quantities were quarried in Bourbon, Neosho, and Phillips Counties. The quantity mined approximated that of 1960.

Output of chats (miscellaneous stone) increased 3 percent in volume and 35 percent in value over 1960. The term "chats" is applied to waste rock derived from past mining operations in the Tri-State district. The increase in value of production of chats was due to a price increase. A publication on quarry operations was released.[12]

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[12] Kline, H. D. Methods and Costs of Mining and Crushing Limestone at Three Quarries, Anderson-Oxandale Rock Co., Kansas. BuMines, Inf. Circ. 8084, 1962, 15 pp.

TABLE 24.—Sand and gravel production in 1961, by counties

(Short tons)

County	Quantity	Value	County	Quantity	Value
Anderson	37,800	$15,120	Marshall	287,401	$310,647
Atchison	12,500	6,250	McPherson	41,725	41,725
Barber	28,688	11,475	Meade	15,785	6,503
Barton	305,562	164,340	Mitchell	6,050	6,655
Chase	31,163	24,930	Morris	23,100	9,240
Cheyenne	52,079	30,121	Ness	70,555	28,222
Clay	99,691	72,492	Norton	4,200	2,250
Cloud	72,683	41,542	Osage	42,000	25,800
Coffey	8,090	3,236	Osborne	40,000	18,000
Comanche	42,572	17,029	Pawnee	117,156	69,850
Cowley	291,233	192,718	Phillips	4,955	1,982
Decatur	1,310	524	Pottawatomie	88,256	75,717
Elk	24,023	9,609	Pratt	31,104	19,042
Ellsworth	31,454	16,396	Reno	334,301	203,070
Ford	272,138	162,321	Rice	214,207	128,444
Franklin	42,480	17,542	Saline	734,180	694,785
Geary	165,000	121,880	Scott	2,280	912
Grant	43,400	16,800	Sedgwick	1,533,770	872,005
Gray	70,025	34,810	Shawnee	462,224	341,415
Greeley	33,500	13,500	Sheridan	26,980	10,792
Hamilton	80,523	32,209	Sherman	86,190	38,405
Harper	120,874	79,743	Smith	41,864	16,746
Haskell	200,207	80,083	Sumner	105,949	52,178
Jackson	58,381	44,568	Thomas	111,137	94,929
Kearny	105,522	52,175	Trego	102,038	89,665
Kingman	60,850	29,400	Wabaunsee	17,483	6,993
Kiowa	100,873	50,824	Wallace	51,225	25,350
Lane	8,250	5,200	Wilson	19,600	10,500
Leavenworth	29,700	27,770	Wyandotte	1,739,933	1,378,729
Linn	473	651	Other counties [1]	2,463,813	1,675,061
Logan	24,300	16,100			
Lyon	90,764	134,464	Total	11,365,569	7,781,434

[1] Includes Dickinson, Douglas, Edwards, Finney, Gove, Republic, Riley, Russell, Stafford, and Washington Counties, combined to avoid disclosing individual company confidential data.

TABLE 25.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone [1]		Miscellaneous stone		Total stone	
	Quantity	Value	Quantity	Value	Quantity	Value
1957	8,871	$11,278	1,540	$648	[2] 10,412	[2] $11,926
1958	11,495	14,653	929	383	[2] 12,424	[2] 15,036
1959	13,367	16,883	632	225	[2] 13,999	[2] 17,108
1960	11,446	14,899	[3] 368	[3] 132	[4] 11,814	[4] 15,031
1961	11,948	16,242	[3] 380	[3] 169	[4] 12,328	[4] 16,411

[1] Includes diatomaceous marl and limestone for cement.
[2] Excludes sandstone.
[3] Includes dimension sandstone.
[4] Excludes crushed sandstone.

Water.—Requirements of water were increasing rapidly due to expansion of industry and growth in population. The State of Kansas took an active part in Federal flood control projects, and in conservation and development of its water resources. Research conducted in ground-water resources by State and Federal agencies resulted in publication of 70 reports on all or part of 72 counties in Kansas.

Studies of flood control authorized by the Flood Control Act of 1960 resulted in construction of numerous reservoirs and other water protective projects by the Federal Government. The U.S. Army Corps of Engineers and the Federal Bureau of Reclamation obligated more than $40.5 million on flood control and irrigation projects. Five

TABLE 26.—Stone sold or used by producers, by kinds of rock and uses

(Short tons)

Uses	1960		1961	
	Quantity	Value	Quantity	Value
Limestone:[1]				
Riprap	536,690	$459,530	608,903	$769,704
Concrete aggregate and road metal	7,842,489	10,618,051	8,240,175	11,414,813
Agriculture	385,704	567,309	437,803	718,186
Cement	2,175,547	2,298.375	2,134,460	2,266,451
Dimension	14,230	136,682	11,269	140,966
Other	[2] 491,189	[2] 819,456	[2] 515,133	[2] 931,805
Total limestone	11,445,849	14,899,403	11,947,743	16,241,925
Sandstone:				
Crushed	(3)	(3)	(3)	(3)
Dimension	930	12,063	425	8,207
Miscellaneous stone	366,864	119,145	379,446	160,718
Total stone[4]	11,813.643	15,030,611	12,327,614	16,410,850

[1] Includes diatomaceous marl.

[2] Includes railroad ballast, cement rock, asphalt filler, coal dust, lime (1961), mineral food, whiting, and other filler.

[3] Figure withheld to avoid disclosing individual company confidential data.

[4] Excludes crushed sandstone.

reservoirs were in various stages of construction; five others were approved for construction.

METALS

Nine small independent mining companies, operating in a part of the Tri-State district that extends into Kansas, reported production of lead and zinc ore from Cherokee County. Value of the metals represented only a very small part of the total mineral output.

The Eagle-Picher Co. produced lead pigments and sulfuric acid at its lead smelter and acid plant near Galena. Concentrates for the smelter came from captive mines and independent producers in the Tri-State area.

Lead.—Although average price per ton at the smelter was $28 less than in 1960, the total value of Kansas lead production increased 63

TABLE 27.—Mine production of lead and zinc, in terms of concentrate and recoverable metals[1]

Year	Mines producing	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content[2]			
						Lead		Zinc	
		Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1952–56 (average)	--------	7,006	$1,294	43,807	$3.811	5,286	$1,585	23,277	$6,160
1957	43	5,703	1,026	29,189	2,311	4,257	1,218	15,859	3,679
1958	25	1,828	242	8,210	499	1,299	304	4,421	902
1959	11	702	93	1,971	149	481	111	1,017	234
1960	4	1,411	129	4,162	314	781	183	2,117	546
1961	9	1,910	222	4,730	311	1,449	298	2,446	563

[1] Based on Kansas ore and old tailing treated at mills during calendar year indicated.

[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

percent. Kansas lead-zinc ore was concentrated at two custom mills, the Central mill of The Eagle-Picher Co. and the Robinson mill of Henderson-Tucker Mining Co.

Zinc.—Output of recoverable zinc increased 16 percent in quantity and 3 percent in value, over that of 1960. The average price of zinc metal decreased from 12.9 cents per pound in 1960 to 11.5 cents per pound. Zinc concentrates were recovered at The Eagle-Picher Co. Central mill and the Henderson-Tucker Mining Co. Robinson mill.

Lead and zinc mining in the Tri-State district began a gradual decline in 1948 and the increase in activity in 1961 did not indicate a revival of the industry in Kansas; it was generated by enactment of the Federal Lead-Zinc Stabilization Act. At yearend, no funds had been appropriated to administer the bill.

REVIEW BY COUNTIES

Mineral production was reported in 102 of the 105 counties, 2 more counties than in 1960. No mineral production was reported in Brown, Ottawa, or Wichita Counties. Oil, gas, or both were produced in 81 counties, 1 more than in 1960. Ninety-one counties produced sand and gravel and/or stone.

The counties that contributed the greatest value of mineral production were those with oil and gas resources. Ellis County was foremost with $29.7 million. A total of 56 counties reported a mineral production value exceeding $1 million. Only those counties with significant mineral production are discussed in the ensuing county review.

TABLE 28.—Value of mineral production in Kansas, by counties [1]

County	1960	1961	Minerals produced in 1961 in order of value
Allen	$11,360,823	$11,212,322	Cement, petroleum, stone, clays, natural gas.
Anderson	1,376,623	1,278,875	Petroleum, stone, sand and gravel.
Atchison	265,172	296,529	Stone, sand and gravel.
Barber	10,923,920	10,648,131	Natural gas, petroleum, gypsum, natural gas liquids, sand and gravel.
Barton	30,455,575	29,418,868	Petroleum, sand and gravel, clays, natural gas, salt.
Bourbon	605,520	660,315	Stone, petroleum, cement, coal.
Butler	22,894,695	22,516,548	Petroleum, stone.
Chase	324,495	379,843	Petroleum, stone, sand and gravel, natural gas.
Chautauqua	2,567,218	2,516,283	Petroleum, stone, natural gas.
Cherokee	3,613,051	3,679,670	Coal, zinc, lead, stone, clays, natural gas.
Cheyenne	55,175	50,669	Sand and gravel, petroleum.
Clark	1,332,782	1,725,994	Natural gas, petroleum, natural gas liquids.
Clay	366,766	159,444	Sand and gravel, stone, petroleum.
Cloud	298,231	(2)	Clays, sand and gravel, stone.
Coffey	352,077	552,581	Stone, petroleum, coal, sand and gravel, natural gas.
Comanche	75,945	484,335	Natural gas, petroleum, sand and gravel.
Cowley	11,557,512	12,190,158	Petroleum, natural gas, sand and gravel, stone.
Crawford	1,768,275	785,744	Coal, stone, petroleum, clays, natural gas.
Decatur	1,083,265	1,308,541	Petroleum, sand and gravel.
Dickinson	1,254,050	805,161	Stone, petroleum, sand and gravel.
Doniphan	376,767	485,740	Stone.
Douglas	292,761	356,597	Petroleum, stone, sand and gravel.
Edwards	2,479,135	2,212,458	Petroleum, natural gas, sand and gravel.
Elk	1,396,986	1,698,704	Stone, petroleum, natural gas, sand and gravel.
Ellis	32,360,376	29,660,153	Petroleum.
Ellsworth	6,128,831	5,694,040	Petroleum, salt, clays, sand and gravel, natural gas.
Finney	7,074,722	8,095,062	Natural gas, petroleum, natural gas liquids, sand and gravel.
Ford	200,126	262,582	Sand and gravel, petroleum, natural gas.
Franklin	1,211,701	1,306,317	Petroleum, clays, stone, sand and gravel.
Geary	592,575	592,150	Stone, sand and gravel, petroleum.
Gove	34,509	539,933	Sand and gravel, petroleum.
Graham	17,595,538	16,882,482	Petroleum.
Grant	16,174,021	17,192,757	Natural gas, natural gas liquids, petroleum, sand and gravel.

See footnotes at end of table.

TABLE 28.—Value of mineral production in Kansas, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Gray	(2)	$34,810	Sand and gravel.
Greeley	$11,090	13,950	Sand and gravel, stone.
Greenwood	13,836.630	12,003,939	Petroleum, stone, natural gas.
Hamilton	528,510	622,552	Natural gas, petroleum, sand and gravel.
Harper	4,217,113	4,361,606	Petroleum, natural gas, sand and gravel.
Harvey	2,039,961	1,748,205	Petroleum, natural gas.
Haskell	11,905,822	13,128,624	Petroleum, natural gas, natural gas liquids, sand and gravel.
Hodgeman	1,169,539	1,589,443	Petroleum.
Jackson	113,999	109,687	Sand and gravel, stone.
Jefferson	(2)	(2)	Stone.
Jewell	(2)	(2)	Do.
Johnson	235,977	247,282	Stone, natural gas, petroleum.
Kearny	8,467,016	9,300,363	Natural gas, natural gas liquids, petroleum, sand and gravel.
Kingman	12,909,879	14,057,516	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	2,884,247	3,371,561	Petroleum, natural gas, sand and gravel.
Labette	449,485	494,339	Petroleum, stone, natural gas.
Lane	------------	46,423	Petroleum, sand and gravel.
Leavenworth	496,919	574,710	Stone, lime, sand and gravel.
Lincoln	(2)	(2)	Stone, pumice.
Linn	529,359	345,693	Stone, petroleum, sand and gravel.
Logan	11,226	20,416	Sand and gravel, petroleum.
Lyon	652,805	529,093	Petroleum, sand and gravel, stone.
Marion	10,515,506	10,457,957	Petroleum, natural gas, stone.
Marshall	494,314	713,842	Gypsum, sand and gravel, stone.
McPherson	10,600,817	8,900,579	Petroleum, sand and gravel, clays, natural gas.
Meade	4,586,950	4,816,426	Petroleum, natural gas, sand and gravel.
Miami	1,373,697	1,108,542	Petroleum, stone.
Mitchell	------------	6,655	Sand and gravel.
Montgomery	4,806,542	4,714,007	Cement, petroleum, stone, clays, natural gas.
Morris	1,407,538	1,630,723	Petroleum, stone, natural gas, sand and gravel.
Morton	12,161,747	14,494,571	Natural gas, petroleum.
Nemaha	39,564	23,545	Petroleum, stone.
Neosho	7,589,812	7,823,487	Cement, petroleum, stone, clays, natural gas.
Ness	1,759,668	1,769,457	Petroleum, sand and gravel.
Norton	2,547,287	2,461,904	Petroleum, pumice, sand and gravel.
Osage	37,400	46,589	Sand and gravel, coal, stone.
Osborne	224,100	191,450	Petroleum, sand and gravel, stone.
Pawnee	4,262,786	3,684,561	Petroleum, natural gas, sand and gravel.
Phillips	5,530,822	5,965,207	Petroleum, sand and gravel, stone.
Pottawatomie	220,463	139,840	Sand and gravel, stone.
Pratt	5,738,777	4,714.604	Petroleum, natural gas, sand and gravel.
Rawlins	1,569,138	2,197,652	Petroleum.
Reno	12,033,380	11,543,543	Salt, petroleum, natural gas, sand and gravel.
Republic	(2)	(2)	Sand and gravel.
Rice	15,862.861	14,389.521	Salt, petroleum, stone, sand and gravel, natural gas.
Riley	791,017	846,845	Petroleum, stone, sand and gravel.
Rooks	16,210,546	16,035.501	Petroleum.
Rush	1,463,376	1,398,107	Petroleum, helium, natural gas.
Russell	25,234,434	23,606,566	Petroleum, sand and gravel, natural gas.
Saline	2,379,310	2,768,230	Petroleum, sand and gravel.
Scott	142,188	215,276	Petroleum, stone, sand and gravel.
Sedgwick	10,114,453	11,047,786	Petroleum, natural gas liquids, salt, sand and gravel.
Seward	6,041,419	6,622,494	Natural gas, natural gas liquids, petroleum.
Shawnee	1,075,343	908,029	Stone, sand and gravel.
Sheridan	1,296,252	857,996	Petroleum, sand and gravel.
Sherman	370,738	283,313	Do.
Smith	5,850	16,746	Sand and gravel.
Stafford	17,445,447	17,648,826	Petroleum, natural gas, sand and gravel.
Stanton	2,398,925	2,964,185	Natural gas, petroleum.
Stevens	12,899,710	15,986,498	Do.
Sumner	9,332,132	9,261,499	Petroleum, sand and gravel, natural gas.
Thomas	102,343	94,929	Sand and gravel.
Trego	4,838,232	4,523,758	Petroleum, sand and gravel.
Wabaunsee	859,255	851,446	Petroleum, stone, sand and gravel.
Wallace	67,560	70,255	Stone, sand and gravel.
Washington	(2)	(2)	Sand and gravel.
Wilson	4,848,931	5,534,924	Cement, petroleum, stone, clays, natural gas, sand and gravel.
Woodson	2,311,381	2,381,813	Petroleum, stone, natural gas.
Wyandotte	7,501.243	7,370,296	Cement, stone, sand and gravel, clays.
Undistributed	3.945,903	4,532,822	
Total	[3] 483,952,000	485,872,000	

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[1] The following counties are not listed because no production was reported in 1960 or 1961: Brown, Ottawa, Wichita.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Allen.—Almost 1 million barrels of crude petroleum was produced from approximately 1,979 producing wells, a decline of 4 percent from 1960. The Bartlesville sandstone of Pennsylvanian age was the most productive formation in the county. Output of natural gas more than doubled; 180.8 million cubic feet was marketed. Allen County ranked first in output of masonry and portland cements and first in the quantity and value of clay used for cement. Lehigh Portland Cement Co. and Monarch Cement Co. manufactured cement. Humbolt Brick and Tile Co. produced miscellaneous clay for manufacturing brick and tile. Limestone was quarried and crushed for cement, concrete aggregate, roadstone, and agricultural stone by Monarch Cement Co., Lehigh Portland Cement Co., Nelson Bros. Quarries, and the county highway department. Webb Block Co. began concrete block production at its new plant near Iola.

Anderson.—Crude petroleum from eight fields declined 10 percent from the 1960 production. Gravel was produced by the county highway department for paving and road maintenance. Hunt Rock Co. and Murray Limestone Products Co. quarried and crushed limestone for concrete aggregate, roadstone, and soil conditioner.

Barber.—The yield of crude oil, from approximately 546 oil wells, declined 10 percent from that of 1960. Exploratory drilling resulted in discovery of one new oilfield during the year. The county ranked sixth in output of natural gas; production was 8 percent under that of 1960. Natural gas liquids were recovered at the Medicine Lodge plant of Skelly Oil Co. The county ranked first in production of crude gypsum. National Gypsum Co. mined and processed gypsum at Medicine Lodge. The county highway department produced sand for paving and road maintenance.

Barton.—Barton County ranked second in mineral production. Over 10 million barrels of crude petroleum was produced from approximately 3,200 active oil wells; the Arbuckle dolomite of Cambro-Ordovician age was the most prolific formation. Seven new oilfields were discovered during the year. Natural gas production increased 17 percent over that of 1960. Pawnee Salt Co. produced evaporated salt at Great Bend. Acme Brick Co. and Kansas Brick & Tile Co. produced fire clay for building brick. Acme Brick Co. discontinued operations at its Great Bend plant and transferred all equipment to its Kanopolis plant in Ellsworth County. Sand and gravel was produced for paving, building, and road maintenance by Arkansas Sand Co., the county highway department, Du Bois Sand Co., James Dirks Sand & Gravel, and Klepper Sand Co.

Bourbon.—A significant increase in crude petroleum production was reported; output was more than double that of 1960. Secondary recovery methods accounted for a large part of the production. Five producing fields were active, the same number as in 1960. All the oil was recovered from the Bartlesville sandstone. Garrett Coal Co. continued operating a strip coal mine near Garland, and Fort Scott Hydraulic Cement Co. produced natural cement at Fort Scott. Dimension sandstone was quarried by Bandera Stone Co. near Redfield. The Fort Scott Reservoir, near Redfield, was in preconstruction stage. Cullor Limestone Co. and Ft. Scott Hydraulic Cement Co., Inc., quarried and crushed limestone for concrete aggregate, roadstone, agricultural stone, and riprap.

Butler.—Butler County ranked fourth in value of petroleum production, although output declined 3 percent from the 1960 figure. Approximately 3,177 oil wells were active. Exploratory drilling resulted in discovery of three new oilfields. Limestone was quarried and crushed for riprap, concrete aggregate, and roadstone by two commercial operators at five locations. The county ranked third in volume of crushed limestone produced. Texas Emulsions, Inc., was constructing an emulsified asphalt plant near El Dorado to prepare paving asphalt from raw material obtained from oil refineries in the area.

Chase.—Over 100,000 barrels of crude oil was produced in Chase County, a decline of 4 percent from the 1960 figure. Production came from 51 active oil wells, 5 more than in 1960. The Bartlesville sandstone of Pennsylvanian age was the most productive formation. Output of natural gas approximated that of 1960. Limestone was mined and crushed for concrete aggregate and roadstone by Riddle Quarries, Inc., near Cottonwood Falls. The county highway department produced gravel for paving and road maintenance.

Chautauqua.—Output of crude petroleum from 2,043 oil wells approximated that of 1960. Exploratory drilling resulted in discovery of one new oilfield near Sedan. Output of natural gas increased more than 21 percent. Sedan Limestone Co. quarried and crushed limestone for concrete aggregate and roadstone.

Cherokee.—Production of natural gas declined 11 percent from 1960; only one well was producing. Cherokee County ranked first in quantity and value of coal produced. Three strip mines were operated, by Pittsburg & Midway Coal Mining Co., Wilkinson Coal Co., and Black Diamond Coal Co. Clay was mined for manufacturing brick by United Brick & Tile Co. near Weir. Limestone was quarried and crushed for riprap, concrete aggregate, and agricultural stone by John J. Stark, Contractor. All miscellaneous stone or chats produced in Kansas came from Cherokee County. The entire production of lead and zinc in the State was mined in the Tri-State district of Cherokee County. The Eagle-Picher Co., lead smelter at Galena, which no longer smelted lead, produced sulfuric acid.

Cheyenne.—Yield of crude petroleum, produced from three wells, declined 50 percent. Two wells were abandoned during the year. New Era Sand & Gravel and Cheyenne County Highway Department produced sand and gravel for paving and building.

Clark.—Production of crude oil, from approximately 77 wells, was about 14 percent under that of 1960. The Harper Ranch field was the most productive for both oil and gas. Output of natural gas increased 17 percent over 1960. Sandstone formations of the Morrowan Group of Pennsylvanian age produced most of the oil and gas.

Skelly Oil Co. placed a new natural gas liquids plant on stream at Minneola.

Clay.—Output of crude petroleum approximated that of 1960. Sand and gravel was produced for building, paving, and road maintenance by Alsop Sand Co., Clay Center Concrete and Sand Co., Inc., and the county highway department. Riddle Quarries, Inc., mined and crushed limestone for concrete aggregate, roadstone, and soil conditioner near Wakefield.

Cloud.—Cloud County ranked first in value of fire clay produced. Fire clay was produced and used by Cloud Ceramics of Concordia in manufacturing building brick. Sand and gravel was produced for building, paving, and road maintenance by Beaver Sand Co. and the county highway department.

Coffey.—Crude petroleum production, from 11 fields, declined 7 percent from 1960. Approximately 224 oil wells were active; the largest production came from the Cherokee and Morrow sandstones of Pennsylvanian age. S. L. Rogers Coal Co. operated a strip mine near Lebo; production declined for the third consecutive year. The county highway department produced gravel for paving and road maintenance. Limestone was quarried and crushed for riprap, concrete aggregate, and agricultural stone by Jones Rock Co., Neosho Valley Rock Co., and Nelson Bros. Quarries. The U.S. Army Corps of Engineers was constructing the embayment and spillway on the John Redman Reservoir near Burlington. The project was scheduled for completion in 1965.

Comanche.—Volume of crude petroleum recovered approximated that of 1960. Almost all oil was produced from wells drilled in sediments of Mississippian age. Exploratory drilling during the year resulted in discovery of two new gasfields. Production of natural gas from the new fields was more than 3 billion cubic feet in 1961. Shamrock Pipeline Co. was constructing a 27-mile pipeline for gas transmission in the county. The county highway department produced sand and gravel for paving, building, and road maintenance.

Cowley.—Crude petroleum production increased 9 percent over 1960. Two new fields were discovered and one field was revived. Approximately 1,644 wells were producing oil, 4 less than in 1960. Over 2 billion cubic feet of natural gas was produced, an increase of 44 percent above 1960 production. Six producers mined sand and gravel for building and paving purposes. Silverdale Limestone Co. and John V. Elam produced dimension limestone. Limestone was quarried and crushed for concrete aggregate, roadstone, and agricultural stone by C. L. Daniels Stone Co. and Geo. M. Myers, Inc.

Crawford.—Yield of crude petroleum, produced from 304 wells, increased 18 percent over that of 1960. Most of the oil was produced from the Bartlesville sandstone. Volume of natural gas output was about the same as in 1960. Crawford County ranked second in output of coal. The Clemens Coal Co., Cliff Carr Coal Co., and The Palmer Coal Co. operated strip mines near Pittsburg and Mulberry. W. S. Dickey Clay Manufacturing Co. processed clay at its plant near Pittsburg and produced sewer tile and other heavy clay products. Limestone was quarried and crushed for riprap, concrete aggregate, and soil conditioner by John J. Stark, Contractor.

Decatur.—Petroleum and sand and gravel were the only mineral commodities produced. The output of crude petroleum from 16 fields increased 20 percent over that of 1960. Exploratory drilling resulted in discovery of four new oilfields; one field was abandoned. The county highway department produced gravel for paving and road maintenance.

Dickinson.—Crude petroleum production, from five oilfields, declined about 6 percent. Approximately 61 producing oil wells were active; 10 were abandoned during the year. Shoffner Sand and Gravel Co.

produced sand for building and paving near Solomon. Limestone was mined for concrete aggregate, roadstone, riprap, and soil conditioner at seven quarries; five were operated by Anderson-Oxandale and two by Riddle Quarries, Inc.

Doniphan.—Stone was the only mineral commodity produced. Geo. W. Kerford Co., Inc., operated three limestone quarries and produced riprap. Limestone was crushed for concrete aggregate and agricultural stone by Everett Quarries, West Lake Quarry and Material Co., and Wolf River Limestone, Inc.

Douglas.—A significent increase in crude petroleum production was reported. Output was 57,529 barrels, an increase of 14,548 barrels over that of 1960. A secondary recovery project in the Baldwin field accounted for a large part of the production. The Cooperative Farms Chemicals Association plant near Lawrence produced ammonia, ammonium nitrate, and nitrogen solutions, using natural gas as raw material. A $2 million expansion project was initiated; new facilities were to increase acid production to 460 tons per day and storage capacity for urea-nitrate solution to 20,000 tons. Sand and gravel was mined near Lawrence for building and paving by Bowersock Mills & Power Co. and Holliday Sand and Gravel Co. Limestone was quarried and crushed for concrete aggregate and agricultural stone by Clark Rock Quarry, Inc.

Edwards.—Crude petroleum output declined 15 percent from that of 1960; production came from the Kinderbook series, of Mississippian age. Natural gas production, from 15 fields, increased 32 percent over that of 1960. Kinsley Sand & Gravel Co. and Showalter Sand & Gravel produced sand and gravel for building and paving.

Elk.—Production of crude oil and natural gas declined 16 percent and 6 percent, respectively, from 1960. Exploratory drilling increased 40 percent. The county highway department produced gravel for paving and road maintenance. The county ranked second in crushed limestone output; limestone was quarried for riprap, concrete aggregate, railroad ballast, and agricultural stone by Concrete Materials & Construction Co.

Ellis.—Ellis County ranked first in total value of mineral production; crude petroleum was the only reported commodity. However, output of crude oil dropped almost 1 million barrels and was 8 percent less than in 1960. Three new oilfields were discovered and one was abandoned.

Ellsworth.—Production of crude petroleum, from 576 producing oil wells, declined 5 percent. Natural gas output from two fields increased 32 million cubic feet. Acme Brick Co. mined fire clay for building brick at its plant near Kanopolis. The county ranked first in production of rock salt; Independent Salt Co. mined salt for use by agricultural and chemical industries. The county highway department, Stoppel Construction Co., and Harry Henery, Inc., produced sand for building and paving. The Federal Bureau of Reclamation was constructing irrigation facilities at the Kanopolis Reservoir. Acme Brick Co. consolidated operations in Kanopolis by moving all equipment at its Great Bend, Barton County plant to Kanopolis.

Finney.—A significant increase in production of crude petroleum was reported as output gained 35 percent over that of 1960. Drilling resulted in discovery of five new oilfields. Natural gas production from the Finney County section of the Hugoton gas area was about the same as in 1960; the county ranked fifth in natural gas production. Northern Natural Gas Co. recovered natural gas liquids at its plant near Holcomb. Sam Alsop Construction Co., of Garden City, and the county highway department produced sand and gravel for building, paving, and water well gravel.

Ford.—Crude petroleum production, from three wells, was more than double the 1960 output. Two new oilfields were discovered; the most important was Little Coon Creek. Natural gas production was approximately the same as in 1960. Sand and gravel was produced for building and paving by Davis & Sons Sand Sales, Dodge City Sand Co., Miller Sand and Gravel Co., and the county highway department.

Franklin.—Crude petroleum output increased 14 percent over that of 1960; secondary recovery projects accounted for most of the oil production. Buildex, Inc., of Ottawa mined shale for use in making lightweight aggregate by the rotary kiln process. The county highway department produced sand and gravel for paving and road maintenance. Dan Fogle quarried and crushed limestone for concrete aggregate, roadstone, and agricultural stone in Ottawa.

Geary.—Output of crude petroleum was 2,289 barrels in 1961; no production was reported for 1960. Junction City Sand & Gravel Co. and More Sand Co. produced sand and gravel for building and paving. Dimension limestone was quarried for construction by Walker Cut Stone Co., near Junction City; at another limestone quarry, near Milford, Walker Cut Stone Co. crushed limestone for concrete aggregate and agricultural stone. Construction of the Milford Reservoir was approved in Washington, D.C. The U.S. Army Corps of Engineers was acquiring land rights preparatory to constructing outlet works and embankment. The entire project was scheduled for completion in 1966.

Gove.—Crude petroleum production, from four fields, increased about 63 percent. Sand and gravel for building and paving was produced by San Ore Construction Co., Inc., Dave Bollinger, and the county highway department.

Graham.—Graham County ranked sixth in value of petroleum output; no other mineral commodity was produced. Production of crude oil was 4 percent less than in 1960. The Lansing-Kansas City sandstone of Pennsylvanian age was the most prolific formation. Exploration during the year resulted in discovery of four new oilfields.

Grant.—Grant County ranked sixth in total value of mineral production. Crude petroleum production increased about 47 percent over that of 1960. Two new gasfields were discovered. The county ranked second in volume of natural gas produced. Output was over 100 billion cubic feet, an increase of 11 percent; all natural gas was produced from the Hugoton gasfield. The county ranked first in value of natural gas liquids recovered; Hugoton Production Co., Pan American Petroleum Corp., and Socony Mobil Oil Co. recovered natural gas liquids at plants in Ulysses. The Pan American plant was the largest in the State. Columbian Carbon Co. at Hickok and United Carbon Co. at Ryus produced the State's entire output of carbon black, from natural gas and LP gases. Pan American Pipeline

Co. was constructing a 50-mile pipeline for gas transmission. The county highway department produced gravel for paving and road maintenance.

Greenwood.—Crude petroleum was produced largely by secondary recovery methods. Production from 2,494 oil wells totaled 4,116,334 barrels of oil, a decrease of 13 percent from that of 1960. Two new oilfields were discovered. The Bartlesville sandstone of Pennsylvanian age was the most productive formation. Over 26 million cubic feet of natural gas was produced; none was reported in 1960. The county highway department and Geo. M. Myers, Inc., quarried and crushed limestone for concrete aggregate and roadstone.

Hamilton.—Production of crude petroleum, from the Morrowan sandstone of lower Pennsylvanian age, declined 10 percent. Natural gas output from part of the Hugoton gasfield was about equal to that produced in 1960. The county highway department produced gravel for paving and road maintenance.

Harper.—Crude petroleum production came from 18 fields and was 6 percent above the 1960 output. Two new oilfields and one new gasfield were discovered. Natural gas yield approximated that of 1960. The county highway department and Harry Henery, Inc., produced sand and gravel for building, paving, and road maintenance.

Harvey.—Crude petroleum production declined 15 percent. Natural gas production, from 14 wells, was double the 1960 output. The Mississippian sand was the most productive formation.

Haskell.—Crude petroleum production was 8 percent more than in 1960. Two new oilfields, the Lemon Northwest and Koswig East fields, were discovered. The Lemon Northwest field was the more important discovery. Natural gas output, from six fields, was 11 percent more than in 1960. Three new gasfields were discovered—Lemon North, Lemon Northwest, and Pleasant Prairie. The Hugoton gas area accounted for 96 percent of the natural gas produced in the county. Northern Natural Gas Co. recovered natural gas liquids at its plant in Sublette. The county highway department and Atchison, Topeka, and Santa Fe Railroad produced sand for road maintenance and railroad ballast.

Hodgeman.—Crude petroleum was the only mineral commodity produced. Output of crude petroleum, from 17 fields, increased more than 35 percent. Exploration activity resulted in discovery of two new oilfields; the Hanston field was the more important.

Jackson.—Sand and gravel was produced for paving by George W. Kerford Quarry Co. and Builders Sand Co. Anderson-Oxandale and G. W. Baker quarried and crushed limestone for concrete aggregate and agricultural stone.

Jefferson.—The county ranked fifth in volume of crushed limestone produced. Roy Baker Stone Co. and N. R. Hamm Quarry, Inc., quarried and crushed limestone for concrete aggregate, roadstone, and agricultural stone.

Jewell.—The county ranked fourth in volume of crushed limestone produced. Ideal Cement Co. quarried limestone in Jewell County for use at its plant in Superior, Nebraska.

Johnson.—The quantity of crude petroleum produced approximated that of 1960. Exploration activity declined 30 percent. Output of natural gas increased 72 percent. Deitz Hill Development Co. and

Reno Construction Co. quarried and crushed limestone for concrete aggregate and roadstone.

Kearny.—Crude petroleum production increased 18 percent over that of 1960. The county ranked fourth in output of natural gas and sixth in recovery of natural gas liquids. Natural gas output was about the same as in 1960; the entire production came from the Hugoton gasfield. Natural gas liquids were recovered at the Colorado Interstate Co. Lakin plant and at the Kansas-Nebraska Natural Gas Co. Deerfield plant. The county highway department and Popejoy Sand & Gravel Co. produced sand and gravel for building, paving, and road maintenance.

Kingman.—Crude petroleum output from 32 fields, was 14 percent more than in 1960. The Mississippian sands were the most productive formations. Natural gas output, mostly from the Spivey-Grabs-Basil field, increased 16 percent over that of 1960. One new gasfield was discovered—Negro Creek. Socony Mobil Oil Co. recovered natural gas liquids, mainly from the Spivey-Grabs-Basil field, at its plant near Spivey. The county ranked fourth in value of natural gas liquids recovered. Building and paving sand was produced by Ray Wells and the county highway department.

Kiowa.—Crude petroleum production, from 115 wells, declined 10 percent. A 186-percent increase in natural gas production was reported. Two new gasfields were discovered—Fralick West and Ursula. Seacat Sand and Excavation and the county highway department produced sand for building, paving, and road maintenance.

Labette.—Crude petroleum production was approximately the same as in 1960; secondary recovery methods accounted for a large part of the production. Natural gas output declined 9 percent. Limestone was mined and crushed for riprap, concrete aggregate, and agricultural stone by John J. Stark, Contractor.

Lane.—The first crude petroleum production in the county was reported in 1961, resulting from discovery of the Pendennis field by Pet-Ex Co., 13 miles northeast of Dighton. The discovery well had an initial production of 42 barrels of oil per day from the Lansing-Kansas City sands of Pennsylvanian age. Drilling activity resulted in the discovery of other new oilfields during the year. Sand was produced for paving by Siebert Sand Co., Inc., near Ness City.

Leavenworth.—Missouri Valley Sand, Inc., produced washed sand for paving, fill, and ready-mixed concrete. Limestone was quarried and crushed for riprap, concrete aggregate, and agricultural stone, by Loring Quarries, Inc. Midwest Lime Co. purchased limestone from Loring Quarries for producing quicklime.

Lincoln.—Quartzite Stone Co. produced sandstone for concrete aggregate, roadstone, railroad ballast, riprap, and filter sand. A small quantity of volcanic ash was produced by Ernest Hanzlicek.

Linn.—Crude petroleum production, from six fields, declined 16 percent from that of 1960. Almost all the crude oil was produced by secondary recovery methods. Lee Giles Rock Co. and Murray Limestone Products Co. quarried and crushed limestone for concrete aggregate and agricultural stone. The county highway department produced gravel for paving and road maintenance.

Logan.—The Monument field in Logan County produced 1,496 barrels of crude petroleum, a decline of more than 60 percent. One well was producing from the Lansing sandstone of lower Pennsylvanian age. Siebert Sand Co., Inc., washed sand for building and ready-mixed concrete.

Lyon.—Crude petroleum production was 20 percent less than in 1960. Seven fields were active. Secondary recovery methods accounted for part of the production. Wesley Parks operated a sand and gravel pit near Emporia for paving and building. Limestone was quarried and crushed for concrete aggregate and agricultural stone by Jones Rock Co.

Marion.—Crude petroleum production was about equal to that of 1960; Mississippian sands were the most productive, with approximately 75 percent of the 1,019 active wells producing from these formations. A 244-percent increase in natural gas production was reported in 1961; more than 3 billion cubic feet was produced. The increased production resulted from discovery of two new gasfields; the Stenzel field was the more important. Walt Keeler Co., Riddle Quarries, Inc., and Anderson-Oxandale, Inc., quarried and crushed limestone for concrete aggregate, roadstone, and agricultural stone.

Marshall.—Gypsum was mined and processed into plaster and plaster products near Blue Rapids by Bestwall Gypsum Co. Building and paving sand and gravel was produced by Blue River Sand & Gravel Co., C. V. Garrett, Heinzelman Construction Co., and Hugo P. Vogler. The county highway department and Hopper Bros. Quarries mined and crushed limestone for concrete aggregate, roadstone, and agricultural stone.

McPherson.—Crude petroleum accounted for nearly all the mineral production value in the county. Production from 1,218 wells, totaled more than 3 million barrels, a decline of 13 percent from production in 1960. Drilling activity resulted in discovery of one new oilfield. Natural gas output declined 44 percent. San Ore Construction Co., Inc., produced and washed sand for paving. Buildex, Inc., a subsidiary of Mackie-Clemens Coal Co., produced lightweight aggregate at its new shale expanding plant near Marquette.

Meade.—Crude petroleum production declined 4 percent, but the output of natural gas increased 14 percent. Gravel for paving and road maintenance was produced by the county highway department.

Miami.—Crude petroleum production, from five fields, declined 18 percent; secondary recovery projects accounted for a large part of the production. Drilling activity was 38 percent greater than in 1960. Limestone was quarried and crushed for concrete aggregate, roadstone, and agricultural stone by the county highway department and L. W. Hayes, Inc.

Mitchell.—Sand was produced for building and paving by Harry Henery, Inc. No mineral production was reported from Mitchell County in 1960.

Montgomery.—Crude petroleum production, from 1,642 wells, declined 7 percent from that of 1960; secondary recovery methods accounted for a large part of the production. Natural gas output declined 10 percent. Clay production was resumed after a shutdown, by United Brick & Tile Co. near Coffeyville. Shale and limestone were mined and used in masonry and portland cements by Universal Atlas Cement Co. at Independence. Limestone was quarried and crushed for riprap, concrete aggregate, and agricultural stone by

H. & S. Rock Co., Nelson Bros Quarries, Inc., and John J. Stark, Contractor. The U.S. Army Corps of Engineers was acquiring land for the Elk City dam and reservoir, 7 miles northwest of Independence.

Morris.—Crude petroleum production increased 6 percent over that of 1960; the Viola limestone of Silurian age was the most productive zone. Natural gas output declined 5 percent. Almost all the natural gas came from Veal gasfield. The county highway department and Metcalf Fill Dirt and Gravel produced gravel for paving, road maintenance, and fill. Limestone was quarried and crushed for concrete aggregate, riprap, and agricultural stone by Anderson-Oxandale and Riddle Quarries, Inc. The U.S. Army Corps of Engineers was constructing the embankment, outlet works, and spillway for the Council Grove dam and reservoir on the Grand (Neosho) River. The project was scheduled for completion in 1965.

Morton.—Crude petroleum and natural gas were the only mineral commodities produced. Crude oil output, from 157 producing wells, increased 12 percent over the 1960 production. Cities Service Petroleum Co. announced its first dual oil producer in the Wilburton field; on initial test, the well flowed 41-gravity oil at a daily rate of 350 barrels. The county ranked third in natural gas production; the yield of natural gas increased 9 percent. The Greenwood and Hugoton gasfields accounted for more than 90 percent of the county's natural gas production. The Richfield West and Wilburton South gasfields were discovered during the year; the former was the largest gasfield discovery in the State in 1961.

Nemaha.—Crude petroleum production was 7,166 barrels, a decline of 29 percent. Anderson-Oxandale quarried and crushed limestone for concrete aggregate and roadstone near Schmitz.

Neosho.—Volume of crude petroleum produced approximated that of 1960; a large part of the oil was produced by waterflooding. Natural gas production declined 28 percent. Ash Grove Lime and Portland Cement Co. mined shale, sandstone, and limestone for cement near Chanute. The county ranked second in production and shipment of masonry and portland cement. Limestone was quarried and crushed for concrete aggregate, roadstone, and agricultural stone by O'Brien Rock Crusher, Nelson Bros. Quarries, Harry Byers and Sons, Inc., and the county highway department.

Ness.—The volume of crude petroleum produced approximated that of 1960. Eighteen oilfields were active, two more than in 1960. Arnold Southwest field was the most important oilfield discovery in the county during 1961. Sand was produced for paving and road maintenance by the county highway department.

Norton.—Crude petroleum production was 4 percent less than in 1960 and came from 171 oil wells in 6 fields. The Arbuckle dolomite of Cambrian age was the most productive formation. The county highway department produced gravel for paving and road maintenance. Pumicite (volcanic ash) was prepared by Wyandotte Chemical Corp. at Calvert.

The Bureau of Reclamation was relocating the Rock Island Railroad, necessary before construction of Norton Reservoir (Almena unit) could start. The entire project was scheduled for completion in 1964.

Osage.—The first commercial oil well in the county was drilled by Messman-Rhinehart Oil Co., but no sale of crude oil was reported. Two coal mines operated during the year, the underground mine of Bill Coal Co. and the strip mine of Johnson Coal Co.; the county ranked third in production of coal. The county highway department produced gravel for paving and road maintenance. Concrete Materials Co. produced limestone for road surfacing.

The U.S. Army Corps of Engineers was relocating roads and utilities and constructing the embankment on the Pomona reservoir. The project was scheduled for completion in 1963.

Osborne.—Crude petroleum production, from three fields, declined 13 percent. Most of the oil was recovered from sandstone horizons in the Shawnee Group of Upper Pennsylvanian age. The county highway department produced gravel and crushed limestone for road maintenance.

Pawnee.—Crude petroleum production was 1.2 million barrels, a decline of 12 percent from that of 1960. Exploratory drilling resulted in discovery of one new oilfield. Natural gas output declined 16 percent. Sand and gravel was produced for paving and building by Johnson Sand and Gravel Co., Larned Sand and Gravel Co. near Larned, and by the State highway department.

Phillips.—Crude petroleum production was 2 million barrels, an increase of 8 percent over that of 1960, and came from 18 fields. One new oilfield was discovered. Gravel was mined for paving and road maintenance by the county highway department. Bushman Construction Co. produced sandstone and used it as base material in building construction and riprap. The Bureau of Reclamation was building irrigation facilities on the North Fork of the Solomon River; O. G. Hansen supplied the sand and gravel.

Pottawatomie.—Anderson-Oxandale and Wamego Sand Co. produced sand and gravel for building and paving. Dimension limestone for building purposes was produced by Bayer Stone Co., Inc. Limestone was quarried and crushed for concrete aggregate and roadstone by Anderson-Oxandale and Bayer Construction Co., Inc.

Pratt.—Crude petroleum production was 1.5 million barrels, a decline of 16 percent from the 1960 output. The Brehm oilfield was discovered during the year. Nearly 2 billion cubic feet of natural gas was produced, an increase of 39 percent. Production from the newly discovered Sawyer and Iuka-Carmi gasfields caused the increase. Sand and gravel was produced for paving, construction, and road maintenance by county highway department, Mrs. C. D. Hogard, and Miller Sand and Gravel Co.

Rawlins.—Crude petroleum was the only mineral commodity produced. Yield, from nine fields, was 761,821 barrels, an increase of 40 percent over that of 1960. A new oilfield was discovered during the year. A sandstone stratum in the Lansing Group of Pennsylvanian age was the most productive source.

Reno.—Crude petroleum production, from 451 wells, was 872,099 barrels, an increase of 12 percent. Drilling activity during the year resulted in discovery of two new oilfields of which Sterling Southwest was the more important. Natural gas production declined more than 1 billion cubic feet. A large part of the production was from the Mississippian sandstone in the Lerado and Burrton fields. Reno county ranked first in both quantity and value of salt produced. Only Carey Salt Co. produced both rock and evaporated salt; Barton Salt Co. and Morton Salt Co. produced evaporated salt only. Sand and gravel was quarried for paving and building by seven producers.

Rice.—Output of crude petroleum, from 1,710 wells, declined 7 percent from that of 1960. Exploration activity resulted in discovery of one of the State's most prolific oilfields—the Tobias (Arbuckle). Four other important fields discovered during the year were Bull Creek (oil), Faler (Simpson—oil), and Lyons Southwest (Arbuckle and Simpson—gas). Production of natural gas declined to 323 million cubic feet, or about 30 percent less than in 1960. Rice County ranked second in value of salt production; American Salt Co. produced evaporated and rock salt near Lyons. Sand and gravel was quarried by four producers. Riddle Quarries, Inc., quarried and crushed limestone for riprap, concrete aggregate, roadstone, and agricultural stone near Little River.

Riley.—The Gee See and Yaege fields in Riley County produced 245,078 barrels of crude petroleum, an increase of 15 percent over that of 1960. Thirty-one wells were active; wells in Pennsylvania conglomerate were the most productive. Sand for paving and building was produced by Walters Sand Co., Inc., near Manhattan. Limestone was mined and crushed for concrete aggregate and roadstone at six quarries by Bayer Construction Co., Anderston-Oxandale, and Grosshans Petersen, Inc.

Construction work on Tuttle Creek dam and reservoir was in final stages during the year. The U.S. Army Corps of Engineers project was scheduled for completion in 1962.

Rooks.—The county ranked seventh in the production of crude petroleum, its only mineral resource; output was about the same as in 1960. A total of 1,440 producing wells were active, 3 less than in 1960. Drilling resulted in discovery of three new oilfields. The Bureau of Reclamation was building irrigation facilities near the Webster reservoir.

Rush.—Total value of mineral fuel production decreased 4 percent. Crude petroleum and natural gas production declined 6 percent and 26 percent, respectively. Lobrey and Reichel gasfields were the largest producers of natural gas. Drilling resulted in discovery of two new oilfields. Production of helium at the Bureau of Mines plant at Otis was 23 million cubic feet, 5 percent more than in 1960.

Russell.—Although total mineral production value declined over $1 million, the county retained its position as third largest mineral producing county. Over 8 million barrels of crude petroleum was produced, a decrease of 2 percent. Producing wells totaled 2,952, a gain of 22 wells over the 1960 total. Exploration activity rose 19 percent and resulted in discovery of three new oilfields and one revived field. Natural gas output decreased 3 percent. Sand and gravel for paving and road maintenance was produced by San Ore Construction Co., Inc., and the county highway department. Government-and-Contractor output of sand and gravel was highest in the State.

The U.S. Army Corps of Engineers began constructing the Wilson dam and reservoir in the spring of 1961. The project was scheduled for completion in 1965.

Saline.—Only two mineral commodities were produced in the county—petroleum and sand and gravel. Yield of crude petroleum, from 16 fields, was 718,764 barrels, an increase of 11 percent over the total of 1960. Of the 336 active oil wells in the county, 70 percent were producing from the Viola limestone of Silurian age. Exploration activity was double that of 1960, as 66 wells were drilled; one new oilfield was discovered. The county ranked third in sand and gravel production. Shoffner Sand, Inc., Salina Sand Co., and Central Kansas Sand, Inc., furnished sand and gravel for paving and construction.

Scott.—Petroleum production gained 37 percent over that of 1960 and accounted for almost all the mineral value in the county. Eight fields were active, two more than in 1960. No natural gas production was reported; however, at yearend, a significant discovery was made about 10 miles north of the Hugoton field. Republic Natural Gas drilled the discovery well that opened the Hugoton North gasfield. The county highway department produced sand and crushed limestone for paving, roadstone, and concrete aggregate.

Sedgwick.—Production of crude petroleum, from 42 fields, decreased 5 percent from that of 1960. A total of 661 oil wells were active, 31 more than in 1960. Exploration resulted in discovery of one new oilfield. Sedgwick County ranked second in recovery of natural gas liquids. Cities Service Petroleum Co. and Kansas Hydrocarbon Co. recovered natural gas liquids at their plants near Wichita and Cheney, respectively; the Cities Service plant was second largest in the State. Frontier Chemical Co. used brine pumped from wells to manufacture chlorine, caustic soda, and salt. The county ranked second in output of sand and gravel. The material was mined for paving and building by 13 commercial operators; Superior Sand Co. produced the largest tonnage. Vermiculite from Western States was exfoliated by Dodson Manufacturing Co. of Wichita; its quantity and value decreased from that produced in 1960.

Construction of Cheney reservoir by the Bureau of Reclamation was in the land-acquisition phase; the project was scheduled for completion in 1966. Derby Refining Co. announced plans to build a $5 million coking plant near Wichita, to produce 150 tons of coke per day. Production for 10 years was contracted to Great Lakes Carbon Co., New York.

Seward.—Crude petroleum production, from 72 oil wells, was 420,564 barrels, a significant increase from the 55,668 barrels produced in 1960. Exploration wells drilled totaled 41, 10 more than in 1960. Two new oilfields and two new gasfields were discovered. Yield of natural gas declined 9 percent; a large part of the production came from an extension of the Hugoton field. Panhandle Eastern Pipeline Co. recovered natural gas liquids at its plant near Liberal. The county ranked third in output of natural gas liquids.

Shawnee.—The county ranked fourth in quantity and value of sand and gravel production. Limestone was quarried and crushed for riprap, concrete aggregate, roadstone, and agricultural stone by Geo. W. Kerford Quarry Co., H. C. Luttjohann, Inc., and Netherland Stone Co.

Sheridan.—Crude petroleum and sand and gravel were the only mineral commodities produced. Crude oil production, from 76 wells, totaled 293,685 barrels, a decline of 35 percent from the 1960 output. The Lansing sandstone of Pennsylvanian age accounted for most of the production. The county highway department produced gravel for paving and road maintenance.

Sherman.—Crude petroleum production came from nine oil wells and was 30 percent less than the 1960 output. Llanos field was the only active oilfield. Two exploratory wells were drilled during the year; both were dry. The county highway department and Siebert Sand Co., produced sand and gravel for paving, building, and road maintenance.

Stafford.—Stafford County ranked fifth in value of mineral production and fifth in production of crude petroleum. Crude petroleum output was 5 percent more than in 1960. Approximately 1,483 wells were active during the year, 49 more than in 1960. Exploration rose sharply and resulted in drilling of 234 wells, an increase of 54. The output of natural gas was more than twice that of 1960. Sand and gravel was produced for building, paving, and road maintenance by the county highway department and Partin Sand and Gravel Co.

Stanton.—Crude petroleum production declined 18 percent from the 1960 output. The number of active producing wells was the same as in 1960. Exploration drilling rose sharply and 27 wells were drilled, compared with 8 in 1960. Drilling resulted in discovery of two new gasfields. Natural gas production increased 9 percent. More than 85 percent of the production came from the section of the Hugoton field in Stanton County.

Stevens.—Crude petroleum production, from 11 oil wells, was 64,722 barrels, a significant increase from the 9,170 barrels produced in 1960. Eleven producing oil wells were active, eight more than in 1960. Drilling resulted in discovery of two new oilfields and six new gasfields. The county led in production of natural gas. Yield was 130 million cubic feet, an increase of 7 percent. A large part of the natural gas production came from the Hugoton gasfield.

Sumner.—The increase in crude petroleum production was 3 percent. Approximately 855 oil wells were active during the year; most wells produced from Pennsylvanian sediments. Exploratory drilling declined 40 percent. Two new fields were discovered, one oil and one gas. Natural gas output increased 19 percent over that of 1960. Mulvane Sand Co., Inc., and Sumner County Engineering Department produced sand and gravel for building and road maintenance.

Trego.—Crude petroleum production came from 30 fields, and was more than 1.5 million barrels, a decline of 3 percent from the 1960 output. Although exploration activity increased, no new oilfields were discovered. Siebert Sand Co., Inc., and the county highway department produced sand and gravel for building, paving, and road maintenance. The Bureau of Reclamation was building irrigation facilities at Cedar Bluff. The project at the Cedar Bluff reservoir was scheduled for completion in 1963.

Wabaunsee.—Crude petroleum, the county's leading mineral commodity, declined about 4 percent. Approximately 35 oil wells were active, most producing from the Viola limestone of Silurian age. The county highway department produced gravel for paving and road maintenance. Limestone was quarried and crushed by Bayer Construction Co. for concrete aggregate and roadstone.

Wallace.—Sand was produced for building and paving by Siebert Sand Co., Inc. National Lead Co., De Lore Division, was the only producer of diatomaceous marl in the State; the quarry was 17 miles south of Edson. Diatomaceous marl was used as paint filler and as a substitute for whiting.

Wilson.—Crude petroleum production was 302,860 barrels, a 50-percent increase over that of 1960. Secondary recovery methods accounted for a large part of the production. Most of the 130 wells drilled were for development and waterflooding projects. Natural gas yield was only 70 percent of that in 1960.

The county ranked fourth in output of cement. General Portland Cement Co. quarried shale and limestone for the manufacture of masonry and portland cements at its plant near Fredonia. Acme Brick Co. quarried shale used to produce acid resistant brick and other specialties. Excelsior Brick Co. used shale in manufacturing brick and other clay products. The county highway department produced gravel for paving and road maintenance. Limestone was mined and crushed for concrete aggregate, roadstone, and agricultural stone by Benedict Rock and Lime Co. and Carr Rock Products Co.

Woodson.—Crude petroleum production was about the same as that of 1960. Approximately 1,126 wells were active, most wells producing from the Bartlesville sandstone of Pennsylvanian age. Secondary recovery projects were active. Nelson Bros. Quarries produced and crushed limestone for concrete aggregate, roadstone, and agricultural stone.

Wyandotte.—The county ranked third in output of cement. Masonry and portland cements were manufactured by the wet process by Lone Star Cement Corp. at Bonner Springs. Wyandotte County ranked second in production of shale utilized for cement and first in the production of sand and gravel and crushed limestone in Kansas. Sand and gravel was mined by seven commercial operators. Peerless Quarries, Inc., Thompson-Strauss Quarries, and J. A. Tobin Construction Co. quarried and crushed limestone for concrete aggregate, roadstone, agricultural stone, and asphalt base. Crude perlite, mined in Western States, was expanded at the Kansas City plant of Panacalite Perlite Co., for building plaster. Both quantity and value of the output increased in 1961.

The Mineral Industry of Kentucky

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Kentucky Geological Survey.

By Harold L. Riley,[1] Preston McGrain,[2] and Mildred E. Rivers[3]

◆

MINERAL production in Kentucky in 1961 was 7 percent below 1960 and 24 percent below 1948, the record year, despite new records for portland cement, miscellaneous clay, lime, and crushed limestone. Coal output decreased 6 percent. Among the States, Kentucky ranked second in ball clay and fluorspar production and third in production of bituminous coal.

Coal mining dominated the Kentucky mineral industry, supplying 66 percent of the total value compared with 68 percent in 1960. Leading companies were Peabody Coal Co., Nashville Coal Co., Pittsburg & Midway Coal Co., River Queen Coal Co., and Gibraltar Coal Co.

TABLE 1.—Mineral production in Kentucky[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite..........short tons..	(2)	(2)	3,304	$30
Clays[3]..........thousand short tons..	951	$2,646	906	2,406
Coal (bituminous)..........do....	66,846	282,395	63,032	256,158
Fluorspar..........short tons..	25,855	1,173	38,898	1,755
Gem stones..........	(4)	(5)	(4)	(5)
Lead (recoverable content of ores, etc.)......short tons..	558	131	656	135
Natural gas..........million cubic feet..	75,329	18,380	70,937	17,592
Petroleum (crude)..........thousand 42-gallon barrels..	21,147	60,268	[6] 18,643	[6] 55,370
Sand and gravel..........thousand short tons..	5,113	5,763	5,582	5,540
Silver (recoverable content of ores, etc.)....troy ounces..	----------	----------	2,065	2
Stone..........thousand short tons..	[7] 15,810	[7] 21,493	17,085	23,309
Zinc (recoverable content of ores, etc.)......short tons..	869	224	1,147	264
Value of items that cannot be disclosed: Cement, ball clay, lime (1961), natural gas liquids, sandstone (1960), and values indicated by footnote 2..........	----------	22,080	----------	24,463
Total Kentucky[8]..........	----------	[9] 413,525	----------	386,013

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Excludes ball clay; included with "Value of items that cannot be disclosed."
[4] Weight not recorded.
[5] Less than $500.
[6] Preliminary figure.
[7] Excludes crushed sandstone; included with "Value of items that cannot be disclosed."
[8] Total adjusted to eliminate duplicating value of clays and stone.
[9] Revised figure.

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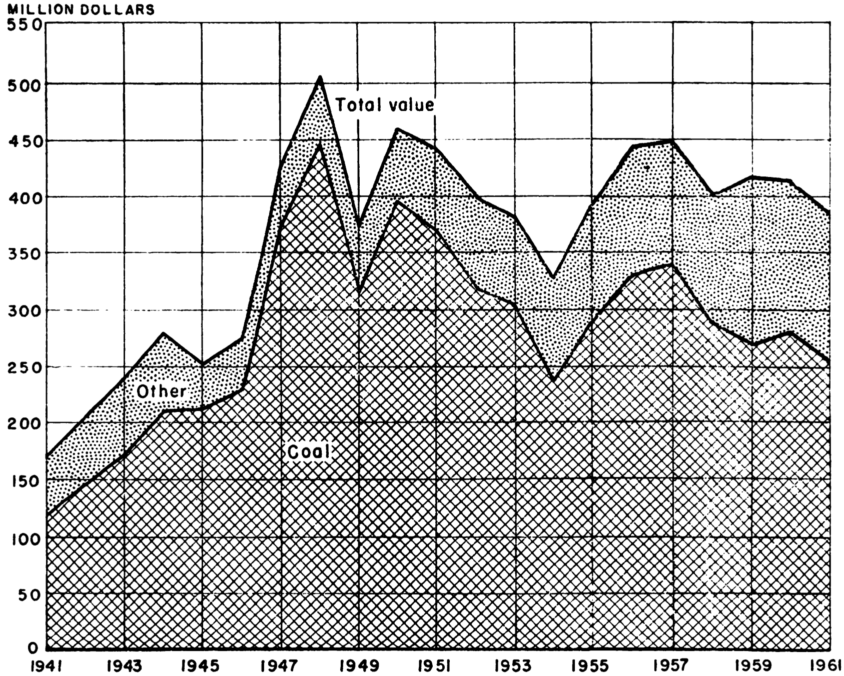

FIGURE 1.—Value of coal and total value of all minerals produced in Kentucky, 1941–61.

Employment and Injuries.—Employment decreased in all mineral industries except the sand and gravel industry. Man-hours worked at coal mines decreased 11 percent, and 4,600 less men were employed, a decline of 16 percent.

Injury experience was about the same as in 1960. Fifty-five fatal injuries occurred, compared with 65 in 1960 and 47 in 1959.

Trends and Developments.—Louisville Gas & Electric Co. added 156,000 kw of steam-electric-generating capacity to the Cane Run plant at a cost of $20 million. Kentucky Utilities Co. started construction of a $17 million addition, with a steam-electric generating capacity of 156,000 kw to the E. W. Brown Generating Station near Dix Dam. Eastern Kentucky Rural Cooperative Corp. broke ground near Burnside for a $25 million steam-electric powerplant with a capacity of 100,000 kw. The City of Owensboro was authorized by the Public Service Commission to build an additional $30 million steam-electric generating plant with an initial capacity of 125,000 kw.

Union Light, Heat & Power Co., subsidiary of Cincinnati Gas & Electric Co., completed an underground propane storage facility with a capacity of 180,000 barrels.

Legislation and Government Programs.—Congress appropriated $73,921,000 for navigation and flood control projects in Kentucky.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operations	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:[1]							
Oil and gas	(2)	4,993	260	10,401,141	1	89	9
Coal mines	2,368	29,724	167	39,331,355	61	1,786	47
Quarries and mills	103	2,303	227	4,182,182	2	144	35
Sand and gravel mines	32	351	291	918,231		18	20
Nonmetal mines and mills	63	682	180	991,504	1	37	38
Coke ovens	1	(3)	(3)	(3)		1	(3)
Total	(2)	(3)	(3)	(3)	65	2,075	(3)
1961:[4] [5]							
Coal mines[1]	2,096	25,099	174	34,853,478	53	1,620	48
Quarries and mills	100	2,088	231	3,855,391	2	121	32
Sand and gravel mines	33	483	278	1,210,531		21	17
Nonmetal mines and mills	56	528	195	822,124		22	27
Coke ovens	2	(3)	(3)	(3)		4	(3)
Total	2,287	(3)	(3)	(3)	55	1,788	(3)

[1] Excludes officeworkers.
[2] Data not available.
[3] Figure withheld to avoid disclosing individual company confidential data.
[4] Excluding gas and oil.
[5] Preliminary figures.

The Kentucky Department of Mines and Minerals established a safety division to conduct an educational safety program with special emphasis on training miners working in truck mines.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Coal production decreased 6 percent and was 25 percent below the 1947 record. Bituminous coal was mined at 1,968 mines in 42 counties, compared with 2,164 mines in 43 counties in 1960. Leading counties were Muhlenberg, Hopkins, Pike, and Letcher. Leading producing companies were Peabody Coal Co., Nashville Coal Co., Pittsburg & Midway Coal Co., River Queen Coal Co., and Gibraltar Coal Co.

Peabody Coal Co. ordered a second 115-cu-yd electric power shovel to be erected in Western Kentucky. Initial shipments of parts were to begin in 1962.

Tennessee Valley Authority contracted with West Kentucky Coal Co. to buy 1 million tons of coal per year for 10 years.

In the Eastern Kentucky coal field, 1,862 mines in 31 counties produced 32,420,000 tons, compared with 2,037 mines in 31 counties and 36,260,000 tons in 1960. Average production per mine decreased from 17,800 to 17,400 tons. Underground mines produced 84 percent; auger mines, 8 percent; and strip mines, 8 percent of the total. Shipments were 83 percent by rail or water and 17 percent by truck. Captive tonnage was 17 percent of the total.

Equipment used at 1,695 underground mines included 1,231 cutting machines, which undercut 81 percent of tonnage; 1,865 power drills, which drilled 89 percent; 411 mobile loading machines, which loaded

53 percent of the tonnage; 35 continuous mining machines, with 14 mobile loaders used in conjunction, which produced 9 percent; and 43 hand loaded conveyors and 5 self-loading conveyors, which loaded 1 percent; plus 963 locomotives, 769 shuttle cars, 371 shuttle buggies, and 85 mother conveyors.

Equipment used at 68 strip mines included 91 power shovels, 5 draglines, 51 bulldozers, 20 power drills, and 196 trucks.

Equipment used at 99 auger mines included 101 coal recovery augers, 17 power shovels, 2 draglines, 2 carryall scrapers, 74 bulldozers, 6 power drills, and 147 trucks.

Of the total coal production, 44 percent was cleaned at 42 cleaning plants, 22 percent was crushed, and 13 percent was treated.

In the Western Kentucky coal field, 106 mines in 11 counties produced 30,612,000 tons compared with 30,587,000 tons in 1960. Average production per mine increased from 241,000 to 289,000 tons. Underground mines produced 38 percent; strip mines, 62 percent of total production. Shipments were 95 percent by rail or water and 5 percent by truck. All coal was sold on the open market.

Equipment used at 59 underground mines included 117 cutting machines, which cut 98 percent of the tonnage; 121 power drills, which drilled over 99 percent of tonnage produced; 94 mobile loading machines, which loaded 97 percent of the tonnage; 104 locomotives, 252 shuttle cars, 68 mother conveyors, and 4 continuous mining machines with 1 mobile loader used in conjunction.

Equipment used at 43 strip mines included 89 power shovels, 32 draglines, 2 carryall scrapers, 102 bulldozers, 52 power drills, and 229 trucks. An estimated 135,300,000 cu yd of overburden was excavated.

Equipment used at four auger mines included four coal-recovery augers, seven bulldozers, and one dragline.

Thirty-four cleaning plants cleaned 84 percent of the coal produced; 40 percent was crushed, and 22 percent was treated with oil or calcium chloride.

Natural Gas.—Marketed production of natural gas decreased 6 percent and was 27 percent below the 1947 record. At yearend, 5,119 gas wells were producing. Cumulative natural gas production for the State since 1883 was 2,151,100 million cubic feet.

Natural Gas Liquids.—*Natural Gasoline.*—Production of natural gasoline increased slightly over 1960.

LP Gases.—Production of liquefied-petroleum (LP) gases increased by a small percentage over 1960.

Petroleum.—Production of crude petroleum decreased 12 percent and was 32 percent below the record established in 1959. At the end of the year, 15,140 oil wells were producing. Leading counties were Henderson, Union, and Daviess, compared with Henderson, Green, and Union in 1960.

TABLE 3.—Coal (bituminous) production by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Bell	1,493,535	$5,827,594	1,743,406	$6,949,555
Boyd	26,001	124,024	89,708	293,091
Breathitt	553,681	3,366,380	555,630	3,268,942
Butler	213,552	959,922	246,271	731,405
Caldwell	45,885	137,655	----------	----------
Carter	18,600	95,790	14,360	66,498
Christian	70,348	404,384	85.605	451.206
Clay	1,284,121	4,662.180	1,372,704	5,221,533
Clinton	38.432	153,728	20,362	40,724
Daviess	967,707	3,354,799	1,018.508	4,609,593
Elliott	16,987	57,586	15.157	60.324
Floyd	4,278,155	25,677,479	3,762,858	21,889,608
Grayson	----------	----------	2,240	7,370
Greenup	----------	----------	3.016	14,386
Hancock	118,311	385.694	----------	----------
Harlan	6,235.601	34.969.612	3,739.809	19,403.439
Henderson	301.209	960,857	250,3[illegible]8	746,096
Hopkins	11,818.541	42,182,858	10,497,856	37,412.196
Jackson	125,726	436.232	69.111	280,877
Johnson	257,535	860,167	183,742	720,269
Knott	1,352,392	4,213,115	2,072,206	5,870.597
Knox	242.939	832,836	256,047	840,682
Laurel	110,074	378.189	31.516	116,331
Lawrence	44.808	153,577	7,253	27,074
Lee	54,340	275.339	43,385	193,063
Leslie	2,290,791	10,123,285	1,679,676	7,001,562
Letcher	4,244,832	23,370,065	4,454.549	23,976,161
Magoffin	73.174	143,421	64,193	283,733
Martin	35,053	119,180	19,156	57,468
McCreary	517,126	1,962,402	474,592	1,793,890
McLean	56,000	189,080	77,991	213,575
Menifee	1,300	6,695	----------	----------
Morgan	37,692	128,460	44,830	133,970
Muhlenberg	9,918,659	32.916,411	11,647.036	38.399,866
Ohio	3,239.246	10,641,826	3,136,378	10,401,309
Owsley	126,550	509,461	100,000	200.000
Perry	4,441,099	19,397,317	3,424,582	14.936,191
Pike	7,619,486	35,162,809	7,462,493	33.428,342
Pulaski	153,704	618,002	128,643	521,985
Rockcastle	38,588	145,476	15,452	55,332
Union	2,832,776	11,284,937	2,575,941	10,316,201
Wayne	9,057	57,149	1.748	10,242
Webster	1,002,374	3,227,657	1,073.598	3,234.457
Whitley	523,380	1,845,350	559,338	1,934,221
Wolfe	15,125	75,625	10,429	44,250
Total	66,846,492	282,394,605	63,031,743	256,157,614
Earliest record to date	2,711,589,000	(1)	2,774,621,000	(1)

[1] Data not available.

TABLE 4.—Crude petroleum production, by counties

County	1960		1961 [1]	
	Barrels	Value	Barrels	Value
Adair	104	$296	18,707	$55.560
Allen	121,929	347,376	92,584	274,974
Barren	37,665	107,308	78,347	232,691
Bath	5,523	15,735	5,594	16,614
Bell	535	1,524	786	2,334
Boyd	673	1,917	714	2,121
Breathitt	301,007	857,569	181,035	537,674
Breckenridge	138,108	393,470	204,205	606,489
Butler	403,105	1,148,446	362,565	1,076,818
Casey	2,520	7,180	23,925	71,057
Christian	1,152,420	3,283,245	1,312,857	3,899,185
Clinton	188,177	536 116	180,422	535,853
Crittenden	376	1,071	89	264
Cumberland	67,252	191,601	47,740	141,788
Daviess	1,611,557	4,591,326	1,643,159	4,880,182
Edmonson	1,679	4,783	1,481	4,399
Elliott	93,161	265,416	79,232	235,319
Estill	116,441	331,740	117,937	350,273
Floyd	24,436	69,618	27,674	82,192
Grayson	154	439	------	------
Green	[2] 2,545,148	[2] 7,250,580	962,909	2,859,840
Greenup	144	410	216	642
Hancock	349,551	995,871	320,616	952,230
Hardin	7,567	21,558	1,120	3,326
Harlan	146	416	------	------
Hart	96,454	274,797	58,411	173.481
Henderson	3,360,740	9,595,492	3,633,651	10,792,231
Hopkins	58,756	167,396	58,382	173,395
Jackson	1,357	3,866	1,242	3,689
Johnson	160,571	457,467	153,051	454,561
Kenton	------	------	1,122	3,332
Knott	17,906	51,014	17,012	50,526
Knox	6,839	19,484	3,322	9,866
Laurel	155	442	1,417	4,208
Lawrence	328,165	934,942	362,396	1,076,316
Lee	1,080,104	3,077.216	1,522,846	4,522,853
Leslie	4.425	12,607	4,707	13,980
Letcher	13,351	38,037	12,035	35,744
Lincoln	65,933	187,843	16.209	48,141
Logan	1,904	5,425	1,331	3,953
Magoffin	1,222,270	3,482,247	1,094,355	3,250,234
Martin	21,222	60,462	20,714	61,521
McCreary	1,110	3,162	1,141	3,389
McLean	641,815	1,828,531	696,587	2,068,863
Menifee	622	1,772	------	------
Metcalfe	217,921	620,857	224,419	666,524
Monroe	8,979	25,581	1,079	3,205
Montgomery	86	245	------	------
Morgan	1,065	3,034	1,236	3,671
Muhlenberg	710,019	2,022,844	773,264	2,296,594
Ohio	989,866	2,820,128	981,708	2,915,673
Owsley	2,226	6,342	1,433	4,256
Perry	862	2,456	4,682	13,906
Pike	45,000	128,205	55,355	164,404
Powell	176,065	501,609	241,350	716,810
Rockcastle	196	558	38	113
Russell	20,318	57,886	10,583	31,432
Simpson	38.452	109,550	9,705	28,824
Taylor	1,746,027	4,974,431	248,240	737,273
Todd	5,975	17,023	10,070	29,908
Union	1,756,882	5,005,357	1,660,691	4,932,252
Warren	46,914	133,658	40,657	120,751
Wayne	24,478	69,738	44,536	132,272
Webster	1,044,274	2,975,137	941,597	2,796,543
Whitley	18.501	52,709	38,836	115,343
Wolfe	39,817	113,439	29,676	88,138
Total	[2] 21,147,000	[2] 60,268,000	18,643,000	55,370,000
Earliest record to date	417,198,000	937,084,000	435,841,000	992,454,000

[1] Preliminary figures.
[2] Revised figure.

Source: Kentucky Geological Survey.

NONMETALS

Barite.—J. Willis Crider Fluorspar Co. mined crude barite in Crittenden County for oil well drilling.

Cement.—Kosmos Portland Cement Co. operated the Kosmosdale plant throughout the year. Shipments of portland cement increased 13 percent and were 3 percent over the previous record year in 1959. Shipments of masonry cement increased 4 percent but were 10 percent below the 1959 record year. Raw materials used in portland cement included limestone (79 percent), miscellaneous clay (17 percent), gypsum (2 percent), and iron ore (2 percent).

Clays.—*Ball Clay.*—Kentucky ranked second in ball clay production. Kentucky-Tennessee Clay Co., Old Hickory Clay Co., and Kentucky Clay Mining Co. mined ball clay at four mines in Graves County for whiteware, stoneware, art pottery, enameling, floor and wall tile, fire clay mortar, kiln furniture, other refractories, fillers, and other uses.

Fire Clay.—Nineteen companies or individuals mined fire clay at 31 mines in five counties for firebrick and block, fire clay mortar, and heavy clay products. Leading producers were General Refractories Co., Davis Firebrick Co., and Harbison-Walker Refractories Co. Leading counties were Carter, Greenup, and Rowan. Production decreased 19 percent and was 57 percent below the 1951 record. Total production was 248,000 tons valued at $1,559,000.

Miscellaneous Clay.—Twelve companies mined miscellaneous clay at 13 mines in 8 counties for floor and wall tile, heavy clay products, lightweight aggregate, and cement. Leading counties were Jefferson, Hancock, and Bullitt. Leading producers were Kenlite Division of Kentucky Light Aggregates, Inc., Kosmos Portland Cement Co., and Owensboro Brick & Tile Co. Production increased 2 percent above the high established in 1960. Total production was 658,000 tons, valued at $847,000.

Fluorspar.—Fluorspar was mined in Caldwell, Crittenden, and Livingston Counties for manufacturing hydrofluoric acid, glass, ceramics, and steel, and for use in iron foundries. Leading producers were Calvert City Chemical Co., Dyers Hill mine; J. Willis Crider Fluorspar Co., Pigmy mine; and Craighead & Coates, Stallions mine. Marketable production increased 16 percent but was 78 percent below the 1941 record. Total marketable production was 31,000 tons, valued at $1,407,000. Total cumulative production from earliest records to date was 2,915,000 tons. Four companies processed or blended fluorspar purchased in Illinois, Kentucky, and Mexico for shipment to consumers. The leading shipper was Kentucky Fluorspar Co. Total shipments to consumers from Kentucky were 39,000 tons, valued at $1,755,000. Kentucky was the second largest fluorspar producing State.

Gem Stones.—The Majors Rocks collected mineral specimens (flint, fossils, calcite, and pyrite) for souvenirs. Total value reported was $300.

Lime.—Air Reduction Chemical & Carbide Co. in plants in Marshall and Jefferson Counties calcined sludge to produce captive lime. Some of the quicklime was hydrated.

Sand and Gravel.—Twenty-three producers, including the State and County highway departments, mined sand and gravel at 33 mines in 21 counties. Leading counties were Jefferson, Boone, and Henderson. Leading producers were Standard Materials Corp., Ohio River Sand Co., and Bedford-Nugent Co., Inc. Production increased 9 percent but was 2 percent below the 1956 record. Of the total commercial production, 95 percent was washed. Seventy-one percent was hauled by truck; 23 percent, by water; and 6 percent, by rail.

Stone.—*Limestone.*—Sixty-nine producers crushed limestone at 94 quarries in 55 counties. Leading counties were Jefferson, Livingston, and Fayette. Leading producers were Kentucky Stone Co.—Anderson, Breckinridge, Hardin, Jessamine, Lee, Logan, Rockcastle, and Todd Counties; Reed Crushed Stone Co., Inc.—Livingston County; and Boonesboro Quarry, Inc.—Madison County. Production increased 8 percent over 1960 and was 6 percent above the 1959 record. Of the total commercial tonnage, 82 percent was hauled by truck; 8 percent, by rail; and 10 percent, by water.

Sandstone.—Kentucky Flagstone Co., Kentucky Kolor Stone, Inc., and Thomas C. Mayne quarried 1,700 tons of dimension sandstone in Logan and McCreary Counties for rough architectural and dressed building stone and flagging.

TABLE 5.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Ballard			18,138	$20,900
Calloway	46,747	$88,570	45,114	91,099
Carlisle	14,500	16,900	11,204	13,000
Fulton	(1)	(1)	83,901	96,900
Gallatin	196,425	163,560	(1)	(1)
Graves	59,500	69,600	52,517	60,900
Hickman	26,150	30,600	22,263	25,800
Jefferson	1,908,473	2,002,247	2,206,389	2,253,676
Livingston	9,272	10,800	6,082	7,000
Lyon	10,033	11,700	13,220	15,340
Marion	15,000	17,550	15,000	17,000
Marshall	18,336	21,400	26,490	30,700
Mason	87,700	140,320	72,500	113,600
Pike	5,800	6,380	5,550	6,327
Union	24,100	30,125	25,000	29,500
Undistributed [1]	2,691,425	3,153,261	2,979,125	2,758,591
Total	5,113,461	5,763,013	5,582,493	5,540,333

[1] Includes the following counties for which figures are withheld to avoid disclosing individual company confidential data; Boone, Breckinridge, Carroll, Daviess, Floyd (1960), Henderson, McCracken, and counties indicated by footnote 1.

TABLE 6.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,203,863	$2,508,751	$1.14	2,054,777	$2,034,156	$0.99
Paving	721,841	737,904	1.02	1,148,959	958,521	.83
Fill	370,303	263,979	.71	236,082	161,477	.68
Glass	11,322	44,385	3.92	14,000	42,000	3.00
Molding	2,700	6,700	2.48	5,000	17,500	3.50
Other	(1)	(1)	(1)	(1)	(1)	(1)
Gravel:						
Paving	793,687	923,772	1.16	1,277,955	1,317,800	1.03
Structural	969,944	1,250,842	1.29	753,077	944,492	1.25
Other	(1)	(1)	(1)	(1)	(1)	(1)
Total sand and gravel	5,113,461	5,763,013	1.13	5,582,493	5,540,333	.99

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

TABLE 7.—Crushed limestone sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Barren	141,000	$180,250	247,000	$342,070
Boyle	219,813	329,695	177,438	273,291
Crittenden	(1)	(1)	250,000	316,650
Fayette	783,298	1,033,089	912,261	1,261,623
Franklin	440,605	556,902	849,825	1,165,131
Hardin	553,287	777,977	547,118	789,259
Jefferson	1,963,126	2,596,071	1,856,749	2,642,799
Kenton	10,320	18,060	12,093	18,139
Mercer	206,000	289,200	137,000	194,800
Morgan	159,412	187,477	172,035	212,575
Muhlenberg	264,049	330,975	302,954	393,874
Nicholas	25,000	30,000	34,000	67,500
Taylor	----------	----------	40,000	40,000
Trigg	133,009	174,705	200,000	250,000
Undistributed [1]	10,908,577	14,951,291	11,344,494	15,314,469
Total	15,807,496	21,455,692	17,082,967	23,282,180

[1] Includes the following counties for which figures are withheld to avoid disclosing individual company confidential data: Adair, Allen, Anderson, Bourbon, Breckinridge, Caldwell, Carter, Casey, Christian, Clark (1960), Clinton, Cumberland (1961), Edmonson, Estill, Fleming, Grayson, Green (1960), Harrison, Hart, Henry, Jackson, Jessamine, Lee, Letcher (1960), Livingston, Logan, Madison (1961), Marion, Meade, Menifee, Metcalfe, Monroe, Nelson, Ohio, Oldham, Pendleton, Powell, Pulaski, Rockcastle, Rowan, Simpson, Todd, Warren, Washington (1960), Wayne, and counties indicated by footnote 1.

TABLE 8.—Crushed limestone sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	12,865,591	$17,736,683	$1.38	13,579,183	$18,677,507	$1.38
Agstone	1,184,605	1,589,804	1.34	1,535,086	2,098,297	1.37
Railroad ballast	(1)	(1)	(1)	317,244	335,780	1.06
Stone sand				32,197	45,621	1.42
Other uses[2]	1,757,300	2,129,205	1.21	1,619,257	2,124,975	1.31
Total	15,807,496	21,455,692	1.36	17,082,967	23,282,180	1.36

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other uses."
[2] Includes riprap, fluxing stone, fertilizer filler, cement, other uses, and uses indicated by footnote 1.

Vermiculite.—Zonolite Co. exfoliated vermiculite from other States at the Wilder plant, near Newport.

METALS

Ferroalloys.—Shipments of ferroalloys, including ferromanganese, silicomanganese, silvery pig iron, ferrosilicon, ferrochromium, and ferrochromic silicon were approximately the same as 1960.

Lead.—Byproduct recovery of lead from fluorspar milling increased 18 percent.

Pig Iron and Steel.—Armco Steel Corp. produced foundry and basic pig iron at Ashland; shipments were 2 percent less than in 1960. Steel was produced by Armco Steel Corp. at Ashland and by Acme Steel Co. at Newport. Iron ore consumed was 19 percent domestic and 81 percent imported. Imports, mainly from Labrador and Brazil, increased 3 percent above the 1960 record.

Zinc.—Byproduct recovery of zinc from fluorspar milling increased 32 percent but was 67 percent below the 1951 record.

REVIEW BY COUNTIES

Of 120 counties, 104 reported mineral production, compared with 106 in 1960. Leading counties were the large coal and petroleum producers, Muhlenberg, Hopkins, Pike, Letcher, Floyd, Harlan, and Union, which supplied more than 50 percent of the total mineral production value. In addition to detailed county production listed in table 9, natural gas and natural gas liquids, of undetermined county origin, were produced.

Adair.—Crude petroleum ranked second in value of minerals produced. Shamrock Stone Co., Inc., Butler quarry, crushed limestone for concrete, roads, and agstone.

Allen.—Crude petroleum ranked first in value of minerals produced. McLellan Stone Co., Scottsville quarry, crushed limestone for concrete, roads, agstone, and other uses.

Anderson.—Kentucky Stone Co. crushed limestone for concrete, roads, railroad ballast, and agstone at the Tyrone mine.

Ballard.—The Kentucky State Highway Department mined paving gravel.

Barren.—Crude petroleum ranked second in value of minerals produced. J. F. Pace Construction Co. crushed limestone for concrete, roads, agstone, and stone sand at the Pace quarry.

Bath.—Crude petroleum was the only mineral produced.

TABLE 9.—Value of mineral production in Kentucky, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value[2]
Adair	(3)	(3)	Limestone, petroleum.
Allen	(3)	(3)	Petroleum, limestone.
Anderson	(3)	(3)	Limestone.
Ballard	------------	$20,900	Sand and gravel.
Barren	$287,558	574,761	Limestone, petroleum.
Bath	15,735	16,614	Petroleum.
Bell	5,829,118	6,951,889	Coal, petroleum.
Boone	(3)	(3)	Sand and gravel.
Bourbon	(3)	(3)	Limestone.
Boyd	177,825	383,927	Coal, miscellaneous clay, petroleum.
Boyle	329,695	273,291	Limestone.
Breathitt	4,223,949	3,806,616	Coal, petroleum.
Breckinridge	(3)	(3)	Petroleum, limestone, sand and gravel.
Bullitt	(3)	(3)	Miscellaneous clay.
Butler	2,108,368	1,808,223	Petroleum, coal.
Caldwell	(3)	(3)	Limestone, fluorspar.
Calloway	88,570	91,099	Sand and gravel.
Carlisle	16,900	13,000	Do.
Carroll	(3)	(3)	Do.
Carter	1,642,993	1,264,459	Fire clay, limestone, coal.
Casey	(3)	(3)	Limestone, petroleum.
Christian	(3)	(3)	Petroleum, limestone, coal.
Clark	(3)	------------	
Clay	4,662,180	5,221,533	Coal.
Clinton	(3)	(3)	Petroleum, limestone, coal.
Crittenden	(3)	(3)	Limestone, fluorspar, barite, petroleum.
Cumberland	191,601	(3)	Petroleum, limestone.
Daviess	(3)	(3)	Petroleum, coal, sand and gravel.
Edmonson	(3)	(3)	Limestone, petroleum.
Elliott	323,003	295,643	Petroleum, coal.
Estill	(3)	(3)	Petroleum, limestone.
Fayette	1,033,089	1,261,623	Limestone.
Fleming	(3)	(3)	Do.
Floyd	(3)	21,971,800	Coal, petroleum.
Franklin	556,952	1,165,171	Limestone, gem stones.
Fulton	(3)	96,900	Sand and gravel.
Gallatin	163,560	(3)	Do.
Graves	1,405,069	(3)	Ball clay, sand and gravel.
Grayson	(3)	(3)	Limestone, coal.
Green	(3)	2,859,840	Petroleum.
Greenup	296,753	272,487	Fire clay, coal, petroleum.
Hancock	1,552,016	1,203,260	Petroleum, miscellaneous clay, fire clay.
Hardin	799,535	792,585	Limestone, petroleum.
Harlan	34,970,028	19,403,439	Coal.
Harrison	(3)	(3)	Limestone.
Hart	(3)	(3)	Petroleum, limestone.
Henderson	(3)	(3)	Petroleum, sand and gravel, coal.
Henry	(3)	(3)	Limestone, gem stones.
Hickman	30,600	25,800	Sand and gravel.
Hopkins	42,351,504	37,585,591	Coal, petroleum.
Jackson	(3)	(3)	Limestone, coal, petroleum.
Jefferson	(3)	(3)	Cement, limestone, sand and gravel, lime, miscellaneous clay.
Jessamine	(3)	(3)	Limestone.
Johnson	1,317,634	1,174,830	Coal, petroleum.
Kenton	18,060	21,471	Limestone, petroleum.
Knott	4,264,129	5,921,123	Coal, petroleum.
Knox	852,320	850,548	Do.
Laurel	378,631	120,539	Do.
Lawrence	1,088,519	1,103,390	Petroleum, coal.
Lee	(3)	(3)	Petroleum, limestone, coal.
Leslie	10,135,892	7,015,542	Coal, petroleum.
Letcher	(3)	24,011,905	Do.
Lincoln	187,843	48,141	Petroleum.
Livingston	(3)	(3)	Limestone, fluorspar, zinc, lead, sand and gravel, silver.

See footnotes at end of table.

TABLE 9.—Value of mineral production in Kentucky, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value[2]
Logan	(3)	(3)	Limestone, sandstone, petroleum.
Lyon	$11,700	$15,340	Sand and gravel.
Madison	----------	(3)	Limestone.
Magoffin	3,625,668	3,533,967	Petroleum, coal.
Marion	(3)	(3)	Limestone, sand and gravel.
Marshall	21,400	(3)	Lime, sand and gravel.
Martin	179,642	118,989	Petroleum, coal.
Mason	140,320	113,600	Sand and gravel.
McCracken	(3)	(3)	Do.
McCreary	1,968,266	1,798,779	Coal, petroleum, sandstone.
McLean	2,017,611	2,282,438	Petroleum, coal.
Meade	(3)	(3)	Limestone.
Menifee	(3)	(3)	Do.
Mercer	289,200	194,800	Do.
Metcalfe	(3)	(3)	Petroleum, limestone.
Monroe	(3)	(3)	Limestone, petroleum.
Montgomery	245	----------	
Morgan	318,971	391,416	Limestone, coal, fire clay, petroleum.
Muhlenberg	35,270,230	41,090,334	Coal, petroleum, limestone.
Nelson	(3)	(3)	Limestone.
Nicholas	30,000	67,500	Do.
Ohio	(3)	(3)	Coal, petroleum, limestone.
Oldham	(3)	(3)	Limestone.
Owsley	515,803	204,256	Coal, petroleum.
Pendleton	(3)	(3)	Limestone.
Perry	19,399,773	14,950,097	Coal, petroleum.
Pike	(3)	33,599,073	Coal, petroleum, sand and gravel.
Powell	(3)	(3)	Petroleum, limestone, miscellaneous clay.
Pulaski	(3)	(3)	Coal, limestone.
Rockcastle	(3)	(3)	Limestone, coal, petroleum.
Rowan	536,852	727,849	Fire clay, limestone, miscellaneous clay.
Russell	57,886	31,432	Petroleum.
Simpson	(3)	(3)	Limestone, petroleum.
Taylor	4,974,431	777,273	Petroleum, limestone.
Todd	(3)	(3)	Limestone, petroleum.
Trigg	174,705	250,000	Limestone.
Trimble	5	----------	
Union	16,324,419	15,281,953	Coal, petroleum, sand and gravel, miscellaneous clay.
Warren	(3)	(3)	Limestone, petroleum.
Washington	(3)	----------	
Wayne	(3)	(3)	Petroleum, limestone, coal.
Webster	6,202,794	6,031,000	Coal, petroleum.
Whitley	(3)	(3)	Coal, petroleum, miscellaneous clay.
Wolfe	189,064	132,388	Petroleum, coal.
Undistributed[4]	[5] 199,976,391	116,792,576	
Total	[5] 413,525,000	386,013,000	

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[1] Excludes natural gas and natural gas liquids; included with "Undistributed." The following counties did not report production: Bracken, Campbell, Garrard, Grant, Larue, Lewis, Owen, Robertson, Scott, Shelby, Spencer, and Woodford.

[2] Other than natural gas and natural gas liquids.

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[4] Includes natural gas, natural gas liquids, and values indicated by footnote 3.

[5] Revised figure.

Bell.—Ninety-one mines produced coal; leading producers were Kentucky Ridge Coal Co., Crockett North Main and Crockett mines, and Bell-Hi Coal Corp., No. 1 Auger mine. Crude petroleum ranked second in value of minerals produced.

Boone.—Standard Materials Corp., Belleview mine, and Kentucky Sand Co., Taylorsport mine, mined structural and paving sand and gravel.

Bourbon.—Hinkle Construction Corp., Farmers quarry, and Bourbon Limestone Co., Inc., Snapp quarry, crushed limestone for concrete, roads, agstone, and stone sand.

Boyd.—Eight mines produced coal; leading producers were Big Run Coal & Clay Co., Inc., Big Run mine, and Charlie Bush Coal Co., No. 1 mine. Crude petroleum ranked third in value of minerals produced. Big Run Coal & Clay Co., Inc., Princess mine, mined miscellaneous clay for use in heavy clay products. Armco Steel Corp. produced pig iron and steel at the Ashland plant.

Boyle.—Caldwell Stone Co., Inc., Danville quarry, and Boyle County Highway Department, Perryville quarry, crushed limestone for concrete, roads, and agstone.

Breathitt.—Seven mines produced coal; leading producers were Island Creek Coal Co., No. 3 Elkhorn mine, and Vires Coal Co., No. 6A mine. Crude petroleum ranked second in value of minerals produced.

Breckinridge.—Crude petroleum was first in value of minerals produced. Kentucky Stone Co., Webster quarry, and White Stone Co., Hardinsburg quarry, crushed limestone for concrete, roads, railroad ballast, and agstone. Ohio Valley Corp., Cloverport mine, mined sand and gravel for structural and paving uses.

Bullitt.—Kenlite Division of Kentucky Light Aggregates, Inc., Shepherdsville mine, mined miscellaneous clay for producing lightweight aggregates.

Butler.—Crude petroleum was first in value of minerals produced. Ten mines produced coal; leading producers were Watson Bridge Mining Co., Aberdeen Strip mine; Boonville Coal Sales Corp., South Hill Strip mine; and M. R. Melton Coal Co., Green River No. 2 mine.

Caldwell.—Cedar Bluff Stone Co., Inc., Cedar Bluff mine, and Fredonia Valley Quarries, Inc., Fredonia quarry, crushed limestone for concrete, roads, and agstone. James Green mined a small quantity of fluorspar at the Tyree mine.

Calloway.—Murray Sand Co., Inc., Murray mine, mined sand for fill, glass, molding, and other uses; the State highway department mined paving gravel.

Campbell.—Zonolite Co. exfoliated crude vermiculite shipped into the State at the Wilder plant.

Carlisle.—The State highway department mined paving gravel.

Carroll.—Standard Materials Corp., Milton mine, and Carrollton Gravel & Sand Co. mined sand and gravel for structural and paving uses.

Carter.—Gollihue & Green Coal Co., No. 4 mine, and More Branch Coal Co., No. 1 Strip mine, were the active coal producers. Seventeen mines produced fire clay for firebrick and block and fire-clay mortar. Leading producers were General Refractories Co., Olive Hill Strip mine, and Harbison-Walker Refractories Co., Stinson mine. Acme Stone Co., Inc., Olive Hill quarry, and Standard Slag Co., Carter quarry, crushed limestone for use in concrete and roads.

Casey.—Crude petroleum ranked second in value of minerals produced. Casey Stone Co. crushed limestone for concrete, roads, and agstone at the Bethel Ridge mine.

Christian.—Crude petroleum ranked first in value of minerals produced. Ralph Ligon, Inc., No. 6 Strip mine, was the only coal producer. Hopkinsville Stone Co., Inc.; Harry Berry, Inc., Fort Campbell quarry; and Christian Quarries, Inc., crushed limestone for concrete, roads, agstone, and stone sand.

Clay.—Seventy mines produced coal; leading producers were Finley Coal Co., No. 5 mine; Oneida Mining Co., Miller's Branch mine; and Shepherd Coal Co., Lick Branch mine.

Clinton.—Crude petroleum ranked first in value of minerals produced. Six coal mines were active; leading producer was O. D. Gwinn Coal Co., Gwinn mine. Shamrock Stone Co., crushed limestone for concrete, roads, and agstone at the Caldwell quarry.

Crittenden.—Crude petroleum ranked fourth in value of minerals produced. Alexander Stone Co., Inc., No. 1 quarry, produced limestone for riprap, concrete, roads, and agstone. J. Willis Crider Fluorspar Co., Pigmy mine, and Craighead & Coates, Stallions mine, mined metallurgical grade fluorspar. Kentucky Fluorspar Co., Roberts & Frazer, and two other brokers purchased fluorspar from local and foreign producers for shipment to a variety of consumers. Calvert City Chemical Co. treated fluorspar ore from its Dyer's Hill mine in Livingston County, in its flotation mill at Mexico, recovering fluorspar for use in manufacturing hydrofluoric acid. J. Willis Crider Fluorspar Co., Pigmy mine, mined barite for use in oil well drilling.

Cumberland.—Crude petroleum ranked second in value of minerals produced. Shamrock Stone Co., Inc., Wells quarry, crushed limestone for concrete, roads, and agstone.

Daviess.—Crude petroleum was first in value of minerals produced. Green Coal Co., K–9 Strip mine, and Morris Enterprises, Morris Strip mine, were the leading coal producers. Six coal mines were active. Owensboro River Sand & Gravel Co. and Daviess County Sand & Gravel Co. mined sand and gravel for structural, paving, fill, and engine uses.

Edmonson.—Crude petroleum ranked second in value of minerals produced. McLellan Stone Co. crushed limestone for concrete, roads, and agstone at the Park City quarry.

Elliott.—Crude petroleum ranked first in value of minerals produced. Copley Coal Co., No. 2 mine, was the leading producer of the three active coal mines.

Estill.—Crude petroleum ranked first in value of minerals produced. Estill County Stone Co. crushed limestone for concrete and roads.

Fayette.—Central Rock Co., Inc., Lexington mine and Lexington quarry; Lambert Bros. Division of Vulcan Materials Co.; and Blue Grass Stone Co., Inc., crushed limestone for concrete, roads, and agstone.

Fleming.—Gorman Construction Co., Inc., Carpenter quarry, crushed limestone for concrete, roads, and agstone.

Floyd.—Floyd County ranked fifth in value of both coal and total mineral production. Crude petroleum ranked second in value of minerals produced. Two hundred and sixty-one coal mines were active; leading producers were Inland Steel Co., Wheelwright mine, and Princess Coals, Inc, No. 1 and Permele No. 2 mines.

Franklin.—Franklin County Stone Co., Frankfort quarry; Blanton Stone Co., Inc., Frankfort mine; and Frankfort Builders Supply Co., Inc., Devil's Hollow mine, crushed limestone for concrete, roads, agstone, and stone sand. The Major Rocks collected a small quantity of gem stones (dolomite, calcite, fluorite, sphalerite, and cerussite).

Fulton.—Hickman Sand & Gravel Co. and the State highway department mined paving sand and gravel.

Gallatin.—Standard Materials Corp., Warsaw mine, and C&H Gravel Co. Inc., Sam Hill mine, mined structural, paving, and fill sand and gravel.

Graves.—Four mines produced ball clay for use in whiteware, art pottery, enameling, floor and wall tile, refractories, fillers and exports. The leading producer was Kentucky-Tennessee Clay Co. The State highway department mined paving gravel.

Grayson.—E. W. Johnson Coal Co., No. 1 Strip mine, was the only coal producer. Ragland Bros. and Rogers & Brunnhoeffer crushed limestone for concrete, roads, and agstone.

Green.—Crude petroleum was the only mineral produced.

Greenup.—Crude petroleum ranked third in value of minerals produced. George Nichols Coal Co., George Nichols No. 5 mine, was the only coal producer. Six mines produced fire clay for use in firebrick and block, heavy clay products, fillers, and other uses. The leading producers were Davis Fire Brick Co. and M. A. McCoy & Sons.

Hancock.—Crude petroleum ranked first in value of minerals produced. Four mines produced miscellaneous clay for use in heavy clay products; the leading producer was Owensboro Brick & Tile Co. Murray Tile Co. mined fire clay for floor and wall tile use.

Hardin.—Crude petroleum ranked second in value of minerals produced. Osborne Bros.; Kentucky Stone Co., Lilmay mine and Upton quarry; and Waters Construction Co. produced crushed limestone for riprap, concrete, roads, agstone, and fertilizer filler.

Harlan.—Harlan County ranked sixth in the State in value of both coal and total mineral production. One hundred and thirty-seven coal mines were active. Stonega Coke & Coal Co., Glenbrook High Splint mine; United States Steel Co., Lynch No. 31 mine; and International Harvester Co., No. 4 mine, were the leading coal producers.

Harrison.—Genet Stone Co., Inc., Cynthiana quarry, and Harrison County Highway Department crushed limestone for concrete, roads, and agstone.

Hart.—Crude petroleum ranked first in value of minerals produced. McLellan Stone Co., Horse Cave quarry, crushed limestone for concrete, roads, agstone, and other uses.

Henderson.—Henderson County ranked first in the State in production of crude petroleum. Eight coal mines were active; leading producers were Dolph Hazlewood Coal Co., Mike & Pat mine, and Goldsberry Coal Co., No. 2 mine. Bedford-Nugent Co., Inc., mined sand and gravel for structural, paving, and fill uses.

Henry.—Geoghegan & Mathis, Inc., Lockport quarry, crushed limestone for concrete, roads, and agstone. Ira Wallace and The Major Rocks collected small quantities of gem material (dolomite, galena, agate, and fossils).

Hickman.—The State highway department mined paving sand.

Hopkins.—Hopkins County ranked second in both coal and total value of mineral production. Crude petroleum ranked second in value of minerals produced. West Kentucky Coal Co., Pleasant View mine; Nashville Coal Co., Inc., Fies mine; and Peabody Coal Co., White City Strip mine, were the leading coal producers. There were 35 active coal mines.

Jackson.—Sturgill Coal Co., Blythe Branch No. 2 mine, was the leading producer of the six active mines. Crude petroleum ranked third in value of minerals produced. M.A. Walker Co., Inc., Indian Creek and Clover Bottom mines, produced limestone for concrete, roads, and agstone.

Jefferson.—Kosmos Portland Cement Co., Inc., produced masonry and portland cements at the Kosmosdale mill. Limestone was crushed at five quarries and two mines for concrete, roads, railroad ballast, and agstone. The leading producers were Louisville Crushed Stone Co., Inc., and Louisville Sand & Gravel Co. Six mines produced sand and gravel for structural, paving, fill, and fertilizer filler uses; leading producers were Ohio River Sand Co., Inc., and R. W. Greene Sand & Gravel Co., Inc. Air Reduction Chemical & Carbide Co. produced lime for chemical and industrial uses at the Louisville plant. Kosmos Portland Cement Co., Kosmosdale mine, produced miscellaneous clay for cement manufacture and General Shale Products Co., Coral Ridge mine, mined miscellaneous clay for brick and other clay products.

Jessamine.—Kentucky Stone Co., High Bridge mine, produced limestone for concrete, roads, railroad ballast, and agstone.

Johnson.—Miller's Creek Coal Corp., No. 1 mine, and Stambaugh Coal Co., No. 1 mine, were the leading coal producers of the 49 active mines. Crude petroleum ranked second in value of minerals produced.

Kenton.—Crude petroleum ranked second in value of minerals produced. The Franxman Bros., Covington quarry, crushed limestone for concrete and roads.

Knott.—Beaver Creek Mining Co., No. 1 mine, and Exeter Coal Co., Inc., Nos. 1 and 2 mines, were the leading coal producers of the 174 active mines. Crude petroleum ranked second in value of minerals produced.

Knox.—Kentucky-Knox Mining Co., Inc., No. 1 Strip mine, was the leading coal producer of the 52 active mines. Crude petroleum ranked second in value of minerals produced.

Laurel.—Margin Coal Co., No. 2 mine, was the leading coal producer of the seven active mines. Crude petroleum production ranked second in value of minerals produced.

Lawrence.—Crude petroleum ranked first in value of minerals produced. C & C Coal Co., Van Horn No. 1 mine, was the leading coal producer of the four active mines.

Lee.—Crude petroleum ranked first in value of minerals produced. Congleton Bros. Coal Co., No. 3 mine, was the leading coal producer of the four active mines. Kentucky Stone Co., Yellow Rock mine, produced limestone for concrete, roads, railroad ballast, and agstone.

Leslie.—Deby Coal Co., Deby No. 2 mine, Liberty Coal Co., Liberty No. 2 mine, and Mary Gail Coal Co., No. 7 mine, were the leading coal producers of the 38 active mines. Crude petroleum ranked second in value of minerals produced.

Letcher.—Letcher County ranked fourth in value of both coal and total mineral production. Bethlehem Mines Corp., No. 22 mine; South East Coal Co., Big Chief mine; and Elkhorn & Jellico Coal Co., Sapphire No. 1 mine, were the leading coal producers of the 235 active mines. Crude petroleum ranked second in value of minerals produced.

Lincoln.—Crude petroleum was the only mineral produced.

Livingston.—Byproduct zinc, lead, and silver were recovered from fluorspar milling. Calvert City Chemical Co. mined fluorspar ore at the Dyer's Hill mine and treated it in the Mexico mill in Crittenden County to recover acid grade fluorspar. Reed Crushed Stone Co., Inc., Grand Rivers quarry, produced limestone for riprap, concrete, roads, and agstone. The State highway department mined paving gravel.

Logan.—Crude petroleum ranked third in value of minerals produced. Kentucky Stone Co., Russellville mine, produced crushed limestone for concrete, roads, and agstone. Kentucky Flagstone Co., Inc., Lewisburg quarry, and Kentucky Kolor Stone, Inc., Russellville quarry, quarried dimension sandstone for rough and dressed building stone.

Lyon.—The State highway department mined paving gravel.

Madison.—Boonesboro Quarry, Inc., Boonesboro mine, produced crushed limestone for concrete and roads.

Magoffin.—Crude petroleum ranked first in value of minerals produced. Tip Top Coal Co., No. 12 mine, was the leading coal producer of the four active mines.

Marion.—Ward & Montgomery, Lebanon quarry, and Lebanon Stone Co., Inc., crushed limestone for concrete, roads, and agstone. Marion County Highway Department mined paving gravel.

Marshall.—The State highway department mined paving gravel. Pittsburgh Metallurgical Co. produced ferroalloys at Calvert City. Air Reduction Chemical & Carbide Co., Calvert City limekiln, produced lime for chemical and industrial use.

Martin.—Crude petroleum ranked first in value of minerals produced. Warfield Mining Co., No. 1 mine, was the leading coal producer of the five active mines.

Mason.—J. F. Hardyman Co. mined sand and gravel for structural, paving, and fill uses.

McCracken.—Federal Materials Co., Inc., Paducah mine, and McCracken County Highway Department mined structural, paving, and fill sand and gravel.

McCreary.—Stearns Coal & Lumber Co., No. 16–2 mine, was the leading coal producer of the five active mines. Crude petroleum ranked second in value of minerals produced. Thomas C. Mayne quarried dimension sandstone for rough building stone at the Day Ridge quarry.

McLean.—Crude petroleum ranked first in value of minerals produced. Highview Coal & Construction Co., Centertown No. 1 Strip mine, was the only coal producer.

Meade.—Kosmos Portland Cement Co., Limestone quarry, mined limestone for cement and Owensboro River Sand & Gravel Co., Inc., Riverside mine, produced crushed limestone for concrete, roads, and agstone.

Menifee.—A. W. Walker & Son, Frenchburg mine, produced crushed limestone for concrete, roads, and agstone.

Mercer.—Mercer Stone Co. and Mercer County Highway Department crushed limestone for concrete, roads, and agstone.

Metcalfe.—Crude petroleum ranked first in value of minerals produced. Montgomery & Co., Chapman quarry, crushed limestone for concrete, roads, and agstone.

Monroe.—Crude petroleum ranked second in value of minerals produced. Trico Stone, Inc., Monroe quarry, crushed limestone for concrete, roads, and agstone.

Morgan.—Marshall & Sheets Coal Co., No. 2 Strip mine, was the leading coal producer of the three active mines. Crude petroleum ranked fourth in value of minerals produced. Licking River Limestone Co., Zag quarry; Kentucky Road Oiling Co., Wrigley quarry; and Morgan County Limestone, Inc., Sandy Hook quarry, produced crushed limestone for riprap, concrete, roads, and agstone. Licking River Limestone Co. mined fire clay for firebrick and block.

Muhlenberg.—Muhlenberg County led the State in value of both coal and total mineral production. River Queen Coal Co., River Queen Strip mine; Peabody Coal Co., Vogue Strip mine; and Gibralter Coal Corp., Gibralter Strip mine, were the leading coal producers of the 24 active mines. Crude petroleum ranked second in value of minerals produced. Greenville Quarries, Inc., produced crushed limestone for concrete, roads, and agstone.

Nelson.—Geoghegan & Mathis, Inc., Nelson quarry, crushed limestone for concrete, roads, and agstone.

Nicholas.—Nicholas County Highway Department, County quarry, crushed limestone for concrete and roads.

Ohio.—Peabody Coal Co., Ken Strip and Ken Highwall No. 2 mines, and Riverview Coal Co., Inc., No. 1 Strip mine, were the leading coal producers. Twelve coal mines were active. Crude petroleum ranked second in value of minerals produced. Fort Hartford Stone Co., Inc., and State Contracting & Stone Co. produced crushed limestone for riprap, concrete, roads, railroad ballast, and agstone.

Oldham.—Ohio River Stone Co., Prospect quarry; Joe Clark Stone Co., Clark quarry; and Liter's Quarry, Inc., Crestwood mine, crushed limestone for concrete, roads, and agstone.

Owsley.—The Wilmuth Corp., Early Bird Strip mine, was the only coal producer. Crude petroleum ranked second in value of minerals produced.

Pendleton.—Geoghegan & Mathis, Inc., Butler and Falmouth quarries, crushed limestone for concrete, roads, and agstone.

Perry.—Blue Diamond Coal Co., Leatherwood Nos. 1 and 2 mines, and Blair Fork Coal Co., Blair Fork mine, were the leading coal producers. There were 104 active coal mines. Crude petroleum ranked second in value of minerals produced.

Pike.—Pike County ranked third in value of both coal and total mineral production. Eastern Coal Corp., Stone mine; Republic Steel Corp., Republic mine; and Kentland-Elkhorn Coal Corp., Kentland No. 1 mine, were the leading coal producers. There were 518 active coal mines. Crude petroleum ranked second in value of minerals produced. Pike Sand Co., Walters mine, mined structural sand.

Powell.—Crude petroleum ranked first in value of minerals produced. A. W. Walker & Son, Whiterock quarry, crushed limestone for concrete, roads, and agstone. Big Run Coal & Clay Co., West Bend mine, and H. B. Sipple Brick Co., Drake No. 1 mine, mined miscellaneous clay for brick and other clay products.

Pulaski.—Ikerd-Bandy Co., Inc., No. 3 Strip mine; Bear Creek Coal Co., No. 1 Bear Creek mine; and L. M. Wilkerson Coal Co., No. 1 Strip mine, were the leading producers of the 10 active coal mines. Strunk Construction Co., Inc., Tateville quarry, and Somerset Stone Co., Inc., Somerset quarry, crushed limestone for concrete, roads, and agstone.

Rowan.—General Refractories Co.—Johnson, Caudill, and Cogswell-Fultz Strip mines—and Harry Hatfield & Co.—Nos. 20 and 24 mines—mined fire clay for firebrick and block. Morehead Limestone Co. and Kentucky Road Oiling Co., Christy quarry, produced crushed limestone for fluxing stone, concrete, roads, and agstone. Lee Clay mine, mined miscellaneous clay for heavy clay products.

Russell.—Crude petroleum was the only mineral produced.

Simpson.—Crude petroleum ranked second in value of minerals produced. Southern Stone Co., Inc., Franklin quarry, crushed limestone for concrete, roads, and agstone.

Taylor.—Crude petroleum was first in value of minerals produced. Taylor County Stone Co. produced crushed limestone for concrete, roads, and agstone.

Todd.—Crude petroleum ranked second in value of minerals produced. Kentucky Stone Co., Todd quarry, and D. W. Dickinson & Son, Gallatin quarry, crushed limestone for concrete, roads, and agstone.

Trigg.—Cedar Bluff Stone Co., Inc., Canton quarry, crushed limestone for concrete, roads, and agstone.

Union.—Union County ranked seventh in value of total mineral production and second in petroleum. Nashville Coal, Inc., Uniontown mine, and P & M Coal Mining Co., Dekoven mine, were the only coal producers. Union Sand & Gravel Co., Morganfield mine, mined structural and paving sand and gravel. Clarks Clay Products Co. mined miscellaneous clay for heavy clay products.

Warren.—Crude petroleum ranked second in value of minerals produced. McLellan Stone Co., Warren and Smith Grove quarries, crushed limestone for concrete, roads, and other uses.

Wayne.—Crude petroleum ranked first in value of minerals produced. Thomas Jones Coal Co., No. 1 mine, was the only coal producer. Bassett Products Co. crushed limestone for concrete, roads, and agstone.

Webster.—Hart & Hart Coal Co., Precision Washed Strip mine, and Sextet Mining Corp., Choctaw Strip mine, were the leading coal producers of the six active mines. Crude petroleum ranked second in value of minerals produced.

Whitley.—Round Mountain Coal Co., Inc., No. 1 Auger and No. 1 Strip mines, and Callihan Coal Co., Inc., Corn Creek Auger mine were the leading coal producers. Fifty-one coal mines were active. Crude petroleum ranked second in value of minerals produced. Corbin Brick Co. mined miscellaneous clay for brick and other clay products.

Wolfe.—Crude petroleum ranked first in value of minerals produced. C. L. Thompson Coal Co., Miller mine, and Herman Nickell Coal Co., No. 1 mine, were the only coal producers.

The Mineral Industry of Louisiana

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey.

By Peter Grandone [1] and Leo W. Hough [2]

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LOUISIANA ranked second among the States in value of mineral production for the fourth consecutive year. To keep pace with accelerated industrial development in the State, new records were made in production of crude petroleum, natural gas, natural gas liquids, sulfur, and salt (in order of value).

Louisiana's mineral industry was dominated by crude petroleum, natural gas, and natural gas liquids, which furnished 94 percent of the total value of mineral output. Proved recoverable reserves of these fuels reached new highs despite increased production. In quantity of reserves added during 1961, Louisiana ranked first in the Nation for petroleum and natural gas and second for natural gas liquids. Nationally, recoverable reserves showed gains for all three fuels, and for petroleum, the net gain approximated that of Louisiana.

TABLE 1.—Mineral production in Louisiana [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	749	$749	645	$645
Lime do	(2)	(2)	927	11,893
Natural gas million cubic feet	2,988,414	511,019	3,271,857	611,837
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons	875,567	66,214	931,176	61,714
LP gases do	606,023	28,147	806,559	33,214
Petroleum (crude) thousand 42-gallon barrels	400,832	1,258,138	[3] 424,962	[3] 1,339,905
Salt thousand short tons	4,792	21,959	4,722	23,357
Sand and gravel do	14,319	19,106	12,042	14,833
Stone (shell) do	4,691	8,882	4,641	7,656
Sulfur (Frasch process) thousand long tons	2,256	52,639	2,352	55,164
Value of items that cannot be disclosed: Cement, gypsum, lime (1960), and miscellaneous stone		24,042		15,807
Total Louisiana [4]		[5] 1,987,967		2,173,442

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing company confidential data; included with "Value of items that cannot be disclosed."

[3] Preliminary figure.

[4] Total adjusted to eliminate duplicating value of clays used for cement and shell used in manufacturing lime and cement.

[5] Revised figure.

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Trends and Developments.—Construction of new plants and additions to existing petrochemical plants, natural gasoline plants, and refineries continued at a high level throughout the year, although increased competition was noted for domestic and foreign markets of petrochemicals. During the year, the Louisiana State Board of Commerce and Industry approved ad valorem tax exemptions on a total investment of $185 million in applications for new manufacturing plants and expansions of existing plants. About three-fourths of the total investment approved was for plants of the power and mineral industries (including fuels). Applications approved in 1960 for new industrial facilities totaled $188 million. Largest of the applications approved in 1961 were $24.8 million for the Michoud electric powerplant of New Orleans Public Service, Inc., $22.1 million for Monochem, Inc., at Geismar, and $15.8 million for Hercules Powder Co. at Lake Charles.

Impressive plant additions were made at three locations. The multimillion dollar petrochemical complex, started by Monochem, Inc., at Geismar on the Mississippi River, was enlarged to eight facilities. Proposed and actual constructions at the Geismar site during the year were made by Allied Chemical Corp. and Union Texas Natural Gas Corp., Naugatuck Chemical Division of U. S. Rubber Co., Borden Co., and Morton Chemical Co. A plant option site was made by Union Oil Co. of California. At Lake Charles, five new plants were proposed or added to the chemical and refinery complex. These constructions were by Continental Oil Co. (ALFOL plant), Ancon Chemical Co., Hercules Powder Co., Cities Service Refining Co., and Pittsburgh Plate Glass Co. (formerly Columbia-Southern Chemical Co.). Near New Orleans, the huge Michoud ordnance plant was reactivated by the National Aeronautics and Space Administration to fabricate booster engines for the Saturn space vehicle. This plant eventually may employ up to 12,000 people and may create a new industrial complex of subcontractor plants to produce numerous component parts for the space vehicle. Also, anticipated facilities and employment in the proposed testing area would enhance the entire economies of St. Tammany Parish, La., and Pearl River County, Miss.

In the salt industry, significant additions were made in mining and chemical plants. New salt mines were under development at the Belle Isle and Cote Blanche salt domes in St. Mary Parish to bring all five island domes into production. New plant facilities to produce chlorine and other chemicals from salt were under construction at Weeks Island and Geismar.

The Mississippi River is one of the greatest industrial attractions to the Baton Rouge-New Orleans area. The river is the Nation's largest fresh-water supply, with an annual flow of over 300 billion gallons a day, which is more water than is used in the entire Nation. The river is navigable for large oceangoing vessels as far as Baton Rouge and provides barge transportation to stations on the Mississippi, Ohio, Illinois, and Missouri Rivers.

The port of New Orleans bulk-unloading facility on the new Mississippi River-Gulf Outlet was put into service. Bestwall Gypsum Co., first industry to contract for use of the unloading facility, commenced operating its $6-million wallboard plant on a 30-acre site adjacent to the terminal. The Mississippi River-Gulf Outlet, which shortened the distance between New Orleans and the Gulf by 50 miles, provides one-way ship traffic and will provide two-way traffic when fully completed in 1969.

Elsewhere in the State, construction of two other major canal and docking facilities was initiated. The Houma Navigation Canal, connecting the Intercoastal Waterway at Houma with the Gulf, gave that east-west artery a branch passing through inland oilfields of south Terrebonne Parish to the tidelands oilfields and sulfur deposits on the Gulf. The $3 million, 36-mile channel was designed for barge traffic, but plans provided for future deepening and widening of its present 15-foot depth and 150-foot width to accommodate deepwater vessels. Upon completion, the navigation channel was expected to make Houma a major terminal on the Intercoastal Waterway and open the area to further industrial development.

The Calcasieu River and Pass, the State's second waterway capable of accommodating seagoing traffic, was scheduled for a deeper and wider channel to permit passage of larger tankers to the port of Lake Charles. Other new port facilities to be constructed at Lake Charles included a canal 6 miles long for industrial waterfront; a $1.8 million bulk-handling plant capable of berthing ships for exporting petroleum coke in 10,000-ton cargoes; and other wharfing and transit facilities. The improved channel and canal, costing the Federal Government $17 million and local interests $3 million, was aimed at further industrial development.

A survey was started in October for construction of the $60 million Toledo Bend Dam on the Sabine River. The project, a cooperative venture of Louisiana and Texas, will create a 181,600-acre lake 65 miles long and will supply 1.6 billion gallons of fresh water daily to the petroleum and petrochemical centers of Lake Charles, La.; and Orange, Beaumont, and Port Arthur, Tex. Hydroelectric facilities to be installed will supply 75,000 kilowatts for peaking purposes. Completion date was set for 1966.

To keep pace with industrial expansion, several Louisiana power and light companies completed new steam electric-generating plants and were expanding facilities at existing stations. Louisiana Power & Light Co. put in operation its Little Gypsy 247,000-kilowatt steam-electric station near the Bonnet Carre spillway of the Mississippi River, in St. Charles Parish. This fully automatic facility was the third plant to feed into the company's power system. New Orleans Public Service, Inc., was constructing its new 230,000-kilowatt Michoud station at New Orleans. Power from this steam-electric station will help meet the demand of the reactivated Michoud ordnance plant. At Caughlin, Rapides Parish, Central Louisiana Electric Co. put into operation a 229,000-kilowatt electric-generating station. On the Calcasieu ship channel, the Gulf States Utilities 90,000-kilowatt Riverside power station was the Nation's first old-type steam-electric plant to go on full electronic control. Steam generation in these four plants was by gas fuel.

The Federal Power Commission reported that the total 12,596 million kilowatt-hours generated in 1961 by all Louisiana plants gained 6.7 percent over 1960 compared with a national gain of 5.2 percent. Also, Louisiana's 1961 electric output was about 1.6 percent of the national output—unchanged from 1960.

Legislation.—The dispute concerning ownership of mineral rights in Gulf Coast tidelands remained unsettled pending completion of the coastal boundary study. A joint team of the State Mineral Board and the United States Coast and Geodetic Survey continued trying to establish a baseline for measuring Louisiana's coastal boundary. Louisiana's exceedingly irregular shoreline makes the baseline crucial. The U.S. Supreme Court allotted the State a 3-mile limit; Congressional action would be required to provide a further limit. Revenues between $300 million and $400 million from offshore leasing in the disputed zones have accumulated in an escrow fund.

A court decision handed down in New Orleans ruled in favor of the oil industry concerning the Federal Aviation Agency regulation on maximum height of derricks. FAA had ruled that special permits would be required for erecting structures that reach 150 feet or more above ground surface. Industry representatives showed that derricks to drill deep wells measure from 140 to 150 feet in height, and usually these are mounted on platforms or barges that measure a minimum of 12 feet above the surface.

Employment and Injuries.—Employment in Louisiana's petroleum industry was 85,330 workers—620 less than in 1960. In mineral production, including fuels (establishments with four or more employees), employment approximated that of 1960. Oil and gas operations provided 91 percent of employment and 93 percent of wages derived from mineral industries in 1961. Reported employment in Louisiana's total industry group in 1961 averaged 535,392 workers, almost 3 percent below the 1960 total.

Four lives were lost and 30 persons were injured in a series of four explosions of May 2, 1961, at the Ethyl Corp. plant in Baton Rouge. The explosions occurred in two washhouses used for purifying tetraethyl lead.

TABLE 2.—Employment and wages in the mineral industries [1]

Activity	Average number of workers		Total wages and salaries (thousands)	
	1960	1961 [2]	1960	1961 [2]
Crude petroleum production, natural gas, and natural gas liquids	19,600	19,310	$135,982	$137,819
Oil- and gas-field contract services [3]	20,230	20,405	112,013	110,799
Sand and gravel quarries, pits, and dredges	1,325	1,330	4,960	4,745
Salt mines	795	780	3,754	3,807
Nonmetallic minerals [4]	1,625	1,585	10,753	11,086
Total	43,575	43,410	267,462	268,256

[1] The Louisiana Employment Security Law covers four or more employees.
[2] Preliminary figures.
[3] Includes approximately 3,300 formerly in service industries. The additional item is geophysical services.
[4] Mainly sulfur, excludes shell production workers.

Source: Louisiana State Department of Labor, Division of Employment Security.

One worker was killed and another seriously injured by explosion of a water heater aboard a pipelaying barge off the coast of Louisiana, on December 27.

At the Jefferson Island salt mine, 1,000 feet below sea level, two men were injured seriously by premature explosion of AN–FO (ammonium nitrate and fuel oil) while loading shot-holes. Cause of the explosion was investigated and reported by the Federal Bureau of Mines.[8]

TABLE 3.—Total wage and salaried workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining (1)	Pipeline transportation (except natural gas)	Gas utilities	Petroleum bulk tank stations	Retail filling stations	Chemicals manufactured as byproducts of petroleum or used in the refining of petroleum [2]	Total
1952–56 (average)	32,578	15,818	1,469	5,042	3.721	6,844	10.808	76,280
1957	42,300	15.700	1,500	5,800	4,700	8,400	12,350	90,750
1958	[3] 41.350	15,450	1,400	6,000	4,600	8,600	13,050	90,450
1959	42,100	13,500	1.320	6.380	4,440	9,000	12,100	88,840
1960 [4]	[3] 40,150	13,350	1,250	6,400	4,300	8,850	11,650	85,950
1961 [5]	40.450	12,850	1,150	6,400	4,250	8,550	11,680	85,330

[1] Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.
[2] Employment in petrochemical manufacturing facilities located outside petroleum refineries.
[3] Includes 3,300 formerly in service industries.
[4] Revised figures.
[5] Preliminary figures.

Source: Louisiana State Department of Labor, Division of Employment Security.

TABLE 4.—Value of construction contracts awarded

(Thousands)

Type	1958	1959	1960	1961	Percent change from 1960
Residential [1]	$245,604	$258,974	$206,129	$219,412	+6.4
Nonresidential [2]	164,070	171,565	182,227	175,226	−3.8
Public works and utilities	268,513	230,716	190,522	194,043	+1.8
Total	678,187	661,255	578,878	588,681	+1.7

[1] Includes apartments, hotels, dormitories, and one- and two-family dwellings.
[2] Includes commercial, manufacturing, educational, and other nonresidential buildings.

Source: Louisiana Business Review, Dodge Statistical Research Service. V. 26, No. 2, February 1962, p. 14.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Louisiana continued to be a leading domestic producer of crude petroleum and natural gas and a major supplier of natural gas liquids and refined petroleum products. The State also had a relatively high rate of activity in all branches of the oil and gas industry. At the end of the year, there were 1,024 oil fields and gasfields in the State containing 31,730 wells capable of producing oil and/or gas.

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[8] Van Dolah, R. W., G. M. Kintz, and W. Marion Baker. Underground Blasting Accidents Involving an Air-Placed Ammonium Nitrate-Fuel Oil Mixture. BuMines Rept. of Inv. 5988, 1962, 13 pp.

The annual Statewide lease sale, held on April 20, realized high bids totaling $16 million for 70,000 acres of scattered onshore and Zone 1 offshore tracts. No lease sale was held for disputed tidelands.

Purchase of gas reserves in place was continued with Tennessee Gas Transmission Co. acquiring the holdings of the CATC group (Continental Oil Co., Atlantic Refining Co., Tidewater Oil Co., and Cities Service Petroleum Co.) in Blocks 198 and 199, Ship Shoal area, offshore from St. Mary and Terrebonne Parishes. The $97 million acquisition contained an estimated 533 billion cubic feet of natural gas reserves and over 16 million barrels of oil and other liquid hydrocarbons. Tennessee Gas Transmission Co. previously purchased gas reserves in the Bastian Bay field and announced plans to tie these reserves into its pipeline system that extends from Texas to New England.

Exploration and Reserves.—Louisiana scored impressive gains in oil and gas reserves as the industry continued to maintain a relatively high discovery rate. Statewide drilling of 3,953 wells (development and exploratory) was 6 percent more than in 1960 and proved 60-percent productive; Statewide drilling of 1,067 exploratory wells (10 percent more than in 1960) proved 25 percent productive. Inland drilling of 924 exploratory wells proved 22-percent productive and led to the discovery of 29 fields—8 oil and 5 gas discoveries in north Louisiana and 7 oil and 9 gas discoveries in south Louisiana.

Despite continued depressed oil markets, regulatory uncertainties, and higher cost of drilling, the offshore oil interests staged a remarkable record by drilling 143 exploratory wells (43-percent productive) and by discovering 7 gasfields, compared with 3 in 1960. New, faster drilling techniques were used to reduce drilling costs in tidelands. In the Timbalier Bay field, the contractor for Gulf Oil Co. drilled 10,000 feet in a world-record time of 27 hours, and the first 7,518 feet of this depth was drilled in 24 hours.

Probably the most significant well drilled in Louisiana's Gulf Coast in 1961 was Continental Oil Co.'s OCS–0813 well in Block 269, Eugene Island area. It was drilled 78 miles from the nearest land in 180 feet of water and was found dry at a total depth of 14,500 feet. Stratigraphic information from the exploratory test was withheld, but geologists estimated that the top of the Miocene (generally oil productive in the Gulf Coast) occurs at approximately 13,000 feet in the area.

Offshore production rose to over 30 percent of the State oil (crude oil and field condensate) output. Enthusiasm in the tidelands continued because these areas were considered promising for development of domestic oil and gas supplies.

According to The Oil and Gas Journal, 29.3 million feet of hole was drilled in the State during the year, or 2 percent more than the footage drilled in 1960. The number of rigs operating offshore averaged 56 in 1961 and 55 in 1960; for the entire State, the average number was 275 in 1961 and 287 in 1960.

TABLE 5.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1961, by parishes

Parish	Drilling							Geophysical, crew-weeks		
	Proved field wells			Exploratory wells			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Acadia	21	13	20	1	7	25	87	41	120	161
Allen	------	------	3	1	1	8	13	------	57	57
Ascension	------	3	3	------	1	1	8	------	3	3
Assumption	3	5	5	------	1	13	27	------	85	85
Avoyelles	------	------	------	------	------	------	------	------	73	73
Beauregard	4	2	6	1	2	12	27	------	64	64
Bienville	1	9	3	------	1	2	16	12	13	25
Bossier	20	31	10	2	2	4	69	------	3	3
Caddo	268	34	34	1	1	2	340	------	3	3
Calcasieu	16	6	12	2	2	22	60	------	96	96
Caldwell	------	1	1	------	1	7	10	------	9	9
Cameron	28	5	24	------	9	28	94	------	149	149
Catahoula	25	------	47	5	------	28	105	------	7	7
Claiborne	15	1	6	4	------	3	29	4	21	25
Concordia	11	------	25	1	------	36	73	------	6	6
De Soto	39	24	35	1	------	5	104	------	------	------
East Baton Rouge	2	------	2	------	------	3	7	------	15	15
East Feliciana	------	------	------	------	------	1	1	------	9	9
Evangeline	4	------	6	2	------	8	20	23	29	52
Franklin	2	------	11	2	------	5	20	11	19	30
Grant	1	------	7	------	------	11	19	------	2	2
Iberia	9	7	7	2	3	9	37	------	129	129
Iberville	15	1	5	1	2	6	30	------	43	43
Jackson	------	3	1	------	4	7	15	5	5	10
Jefferson	37	6	12	1	2	12	70	7	59	66
Jefferson Davis	3	4	7	2	1	25	42	------	94	94
Lafayette	1	1	4	1	8	5	20	------	66	66
Lafourche	81	24	31	2	4	21	163	------	169	169
La Salle	57	------	44	3	1	15	120	------	26	26
Lincoln	1	10	2	------	8	------	21	3	11	14
Livingston	------	------	1	------	------	1	2	------	8	8
Madison	------	------	------	------	------	4	4	------	14	14
Morehouse	------	2	2	------	------	------	4	------	------	------
Natchitoches	1	------	3	------	------	3	7	------	------	------
Orleans	------	1	------	------	------	------	1	------	------	------
Ouachita	------	17	4	------	------	3	24	2	22	24
Plaquemines	176	10	34	13	4	39	276	5	187	192
Pointe Coupee	2	1	4	1	1	11	20	------	12	12
Rapides	------	------	2	1	------	2	5	------	24	24
Red River	7	1	6	1	------	7	22	------	------	------
Richland	1	1	5	1	------	4	12	------	6	6
Sabine	63	------	63	16	------	9	151	------	3	3
St. Bernard	------	------	------	------	2	5	7	------	46	46
St. Charles	17	2	9	------	1	10	39	------	27	27
St. Helena	------	------	------	------	------	1	1	------	14	14
St. James	1	------	------	1	------	1	3	------	6	6
St. John the Baptist	1	------	------	------	------	3	4	------	9	9
St. Landry	9	12	12	3	2	10	48	39	128	167
St. Martin	28	6	8	3	3	16	64	------	158	158
St. Mary	57	18	4	4	10	20	113	------	147	147
St. Tammany	------	------	------	------	------	3	3	------	15	15
Tangipahoa	------	------	------	------	------	4	4	------	30	30
Tensas	20	3	9	6	1	15	54	------	7	7
Terrebonne	130	32	22	4	12	34	234	7	387	394
Union	1	128	10	------	1	6	146	------	16	16
Vermilion	9	15	13	1	10	45	93	7	160	167
Vernon	------	------	------	------	------	------	------	------	97	97
Washington	------	------	------	------	------	6	6	------	2	2
Webster	16	6	14	2	------	4	42	6	15	21
West Baton Rouge	1	------	------	------	------	2	3	------	------	------
West Carroll	------	------	------	------	------	1	1	------	------	------
Winn	143	------	98	3	------	127	371	8	11	19
West Feliciana	------	------	------	------	------	1	1	------	5	5
Total:										
1961	1,347	445	696	95	108	721	3,412	180	2,941	3,121
1960	1,255	437	621	102	103	641	3,159	110	3,195	3,305

TABLE 5.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1961, by parishes—Continued

Parish	Drilling							Geophysical, crew-weeks		
	Proved field wells			Exploratory wells			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Offshore:										
Bay Marchand	62	5	11	1	1	--	80	--	--	--
Breton Sound	--	--	--	--	1	3	4	--	4	4
Cameron, East	--	6	--	--	4	--	10	--	43	43
Cameron, West	--	2	6	--	8	11	27	--	44	44
Delta, West	34	4	5	2	3	3	51	8	49	57
Eugene Island	31	5	12	2	2	17	69	10	56	66
Grand Isle	32	5	8	2	4	3	54	8	31	39
Main Pass	21	--	4	3	1	8	37	3	13	16
Marsh Island, South	7	8	1	--	5	9	30	--	34	34
Pelto, South	3	--	1	--	--	--	4	--	2	2
Ship Shoal	18	5	6	7	3	16	55	8	63	71
South Pass	65	2	2	1	2	2	74	11	35	46
Timbalier, South	12	1	6	2	--	2	23	14	74	88
Vermilion	--	6	2	--	7	8	23	--	24	24
Total:										
1961	285	49	64	20	41	82	541	62	472	534
1960	285	58	88	23	28	71	553	8	257	265
Grand total:										
1961	1,632	494	760	115	149	803	3,953	242	3,413	3,655
1960	1,540	495	709	125	131	712	3,712	118	3,452	3,570

Source: International Oil Scouts Association, International Oil and Gas Development, Austin, Texas, vol. 31, 1961.

Formations of Cretaceous and Eocene ages received special attention in the geologic province of the middle and northern parishes. Vernon Parish joined the ranks of oil producers when Pan American Petroleum Co. completed its Lutcher-Moore Lumber Co. No. 1 well in sec. 11, T. 1 S., R. 11 W. Production of 8 million cubic feet of gas and 50 to 100 barrels of condensate per day was from the 11,622- to 11,638-foot interval of the Wilcox (Lower Eocene) formation. Although the well was drilled to test the deeper Edwards Limestone of Lower Cretaceous age, it was completed in the Wilcox formation when an unexpected substantial flow of gas was encountered. The Edwards Limestone objective was the extension of a leasing play that originated in south Texas (where prolific oil and gas production was established) and spread eastward into the oil-poor parishes of central Louisiana.

One of the largest mineral transactions ever reported for north Louisiana involved a 133,000-acre block in Caldwell, Winn, and Grant Parishes. A 5-year lease on the block was taken by Marshall R. Young Drilling Co. from Olin Mathieson Chemical Corp. Terms of the lease did not require a cash bonus or yearly rental, but they did obligate the lessee to drill 100 wells to test the Wilcox formation (Lower Eocene) during the first 3 years and then one 8,000-foot well each succeeding 6-month period for the remaining 2 years. Interest in the area was stimulated in 1961 by discoveries of new reserves in the Vixen and Calhoun gasfields and in the Colgrade oilfield.

TABLE 6.—New oil and gas discoveries in 1961, by parishes

Parish and field	Total depth (feet)	Production depth (feet)	Daily production rate		Type of product
			Barrels	Thousand cubic feet	
North Louisiana:					
Bossier: Scottsville	9,526	8,605- 8,609	----------	1,300	Gas.
Catahoula: Kincaid	6,009	5,464- 5,471	109	----------	Oil.
Concordia: Lake Curry	6,768	6,608- 6,611	87	13	Do.
De Soto: Hunter	3,106	1,312- 1,333	10	----------	Do.
Jackson: Hodge	9,090	8,479- 8,489	----------	6,600	Gas.
La Salle: West Searcy	4,301	1,909- 1,911	18	----------	Oil.
Ouachita: Cheniere	10,312	9,683- 9,698	527	4,500	Gas.
Sabine:					
Fort Jessup	3,560	3,008- 3,140	30.9	----------	Oil.
Many	3,122	3,074- 3,118	168	30	Do.
Tensas:					
Cow Slough	8,933	8,748- 8,759	144	72	Do.
Crimea	8,660	8,496- 8,548	48	580	Gas.
Hard Bargain	8,795	8,480- 8,496	114	116	Oil.
Union: South Downsville	9,395	9,024- 9,039	168	4,149	Gas.
South Louisiana:					
Allen: Southwest Kinder	9,500	8,082- 8,084	----------	2,145	Do.
Ascension: Gonzales	11,848	11,741-11,783	168	4,908	Do.
Beauregard: West Merryville	12,030	11,516-11,550	36	674	Do.
Calcasieu: Buhler	9,331	8,582- 8,590	123	86	Oil.
Cameron: Ocean View Beach	12,834	10,006-10,026	9	2,066	Gas.
Iberville: Klondike	11,014	10,319-10,324	369	262	Oil.
Plaquemines:					
Bay Denesse	11,918	11,162-11,166	227	460	Do.
Bohemia	14,505	12,030-12,034	76.8	2,200	Gas.
Rapides: Lecompte	9,795	9,727- 9,734	24	----------	Oil.
St. Martin:					
Loreauville	16,500	13,787-13,791	38	2,100	Gas.
North Cecelia	11,025	9,624- 9,697	300	690	Oil.
Willow Cover	14,047	13,952-13,963	156	254	Do.
St. Mary: E. Atchafalaya Bay	12,450	10,714-10,720	.61	4,175	Gas.
Terrebonne:					
Bay LeFleur	17,299	14,203-14,211	----------	----------	Do.
S.W. Bourg	15,023	11,518-11,522	----------	2,225	Do.
Trinity Bayou	14,385	14,076-14,096	126	132	Oil.
Offshore:					
Cameron: West Cameron Block 1	14,972	11,425-11,427	3.8	2,110	Gas.
Iberia:					
Eugene Island Block 205	10,251	5,368- 5,398	----------	2,000	Do.
S. March Island Block 48	9,783	6,780- 6,810	12	1,810	Do.
Plaquemines: Breton Sound Block 49	10,082	8,836- 8,846	11	1,235	Do.
Terrebonne: Ship Shoal Block 186	11,200	4,219- 4,229	----------	2,355	Do.
Vermilion:					
Vermilion	14,303	12,266-12,274	36	5,000	Do.
Block 16	----------	12,287-12,294	----------	----------	
Block 129	12,818	12,072-12,085 12,112-12,120	90	4,416	Do.

Source: Louisiana State Department of Conservation, Annual Oil and Gas Report 1961, pp. 8-10.

A published bulletin[4] revived drilling interest for oil and gas in Sabine Parish. The publication pointed out that current fracturing techniques might increase oil production from the chalk formations in the old Zwolle field; it also mapped the Fisher fault zone which controls new production in the Pendleton-Many-Zwolle oilfield complex. As a result of this information, drilling immediately south of the Zwolle field in Sabine Parish resulted in the discovery of oil in as many as three zones of the Saratoga and Annona chalk formations of Upper Cretaceous age. These two formations, each ranging in thickness up to 100 feet, occur at top depths of about 2,700 and 2,900 feet, respectively, in the area.

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[4] Andersen, H. V. Geology of Sabine Parish. Louisiana Geol. Survey, Geol. Bull. 34, 1960, 164 pp.

Proved recoverable reserves of crude petroleum, natural gas, and natural gas liquids in Louisiana reached a new high despite increased withdrawal of each. Much of the increase in reserves came from extensions and revisions of previous estimates involving pools and fields discovered before 1961. The State petroleum reserves increased by 146 million barrels (largest gain in the Nation and equal to the total net U.S. gain) to a new record total of 4,931 million barrels (16 percent of the Nation's total oil reserves). About 32 percent of the crude petroleum reserve was offshore, as compared with 30 percent in 1960. Natural gas reserves increased by 2.6 trillion cubic feet (net increase for the Nation was 4 trillion cubic feet) to a new record total of 66 trillion cubic feet (25 percent of the U.S. total). Natural gas liquids reserve increased 61 million barrels (26 percent of the U.S. net increase) to a new record total of 1,494 million barrels (21 percent of the U.S. total).

Carbon Black.—Output of carbon black from natural gas and petroleum distillates declined 7 percent from 1960. The product was mainly used as an additive in rubber manufacturing.

Natural Gas.—Marketed production of natural gas continued a strong upward trend for the 16th consecutive year, and Louisiana retained second position in the United States as a supplier of natural gas. National demand for gas as a fuel for heating and power and as a raw material for petrochemicals continued to grow rapidly. Offshore pipelines construction was continued to provide market outlets for added gas reserves.

According to the Louisiana Department of Conservation, State net production of natural gas, 3,130.6 billion cubic feet, gained 5 percent over 1960. About 17 percent of this net production was credited to

TABLE 7.—Crude petroleum, natural gas, and natural gas liquids production and addition to reserves

Year	Crude petroleum (million barrels)		Natural gas (billion cubic feet)		Natural gas liquids (million barrels)	
	Production	Net additions to reserves	Production	Net additions to reserves	Production	Net additions to reserves
1952	244	273	1,237	2,447	23	29
1953	257	202	1,294	3,007	23	100
1954	247	202	1,399	2,341	23	71
1955	271	294	1,680	5,636	26	52
1956	299	420	1,886	2,618	26	79
1957	330	182	2,079	6,382	26	4
1958	314	186	2,452	3,676	28	177
1959	363	616	2,670	4,742	33	162
1960	401	125	2,988	3,532	35	75
1961	[1] 425	146	3,272	2,643	41	61

TOTAL PROVED RESERVES BY DEC. 31, 1961

Year	Crude petroleum	Natural gas	Natural gas liquids
1961	4,931	66,029	1,494

[1] Preliminary figure.

Source: Reserves based on American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas: Vols. 7-16, 1952-61.

TABLE 8.—Carbon black production

Year	Million pounds	Year	Million pounds
1952–56 (average)	408	1959	599
1957	534	1960	631
1958	503	1961	583

north Louisiana, 68 percent to south Louisiana, and 15 percent to the offshore area, about the same percentages as in 1960.

The first quadruple well completion in north Louisiana, the Archie Davis No. 1, was brought into production by Marion Oil Co. and Del Cryer in the Ada field, Webster Parish. The well produced substantial flows of gas and some condensate from the Jeter, Hill, Cook, and Pettet zones that range from 5,336 feet to 5,654 feet in depth.

Four gas transmission pipelines were under construction. Texas Gas Transmission Corp. was laying 52 miles of 20-inch, 16-inch, and 8-inch line from Bay Round to Morgan City and 21 miles of 26-inch line in Arkansas and Louisiana. Franklin Gas Co., Houston, Tex., was laying 35 miles of 26-inch line from Cow Island in Vermilion Parish to Jennings in Jefferson Davis Parish. Texas Eastern Transmission Corp. began expanding its gas-delivery capacity by 225 million cubic feet daily. The $85 million expansion was to be completed in two steps: First, a 165-mile, 20-inch line from West Monroe, La., to Kosciusko, Miss., and second, a 128-mile loop of 30-inch line between Kosciusko and Lambertville, N.J.

TABLE 9.—Natural gas data

(Million cubic feet)

Year	Withdrawals [1]			Marketed production [2]	Value at wells (thousands)	Disposition	
	From gas wells	From oil wells	Total			Repressuring	Vented and wasted [3]
1952–56 (average)	1,395,180	387,800	1,782,980	1,499,269	$143,676	205,180	78,531
1957	1,877,000	470,000	2,347,000	2,078,901	232,837	187,057	81,042
1958	2,223,000	505,000	2,728,000	2,451,587	316,255	220,616	55,797
1959	2,442,000	514,000	2,956,000	2,670,271	411,222	186,599	99,130
1960	2,691,000	622,000	3,313,000	2,988,414	511,019	219,411	105,145
1961	2,930,100	640,700	3,570,800	3,271,857	611,837	201,989	96,954

[1] Marketed production plus quantities used in repressuring, vented, and wasted.

[2] Comprises gas sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas in pipelines.

[3] Partly estimated. Includes direct waste on producing properties and residue blown to the air.

At Lake Charles, a new method of storing liquefied natural gas was demonstrated by Conch Methane Services, Ltd., London, and Constock-Pritchard Liquefaction Corp., Kansas City, Mo. The Conch method uses a cavity in frozen ground to store the liquid methane. The ground was prefrozen by a refrigerant conducted through underground pipes. When the ground surrounding an area 20 feet in diameter was frozen, the inner core of earth was excavated, leaving a well 20 feet deep with a capacity of 850 barrels. A vaportight aluminum roof was installed and the well filled with liquid methane.

During a 30-day test period, project scientists found no gas leaks and encountered no ground swelling problems.

Natural Gas Liquids.—Louisiana again held second position as a producer of natural gas liquids, and again registered the largest increase in daily processing capacity. New plants and expansions added in 1961 raised the State's daily gas processing capacity from 7.71 to 10.05 billion cubic feet.

Natural gasoline and cycle products were recovered by 84 plants (6 more than in 1960) in 31 parishes. Increased output of total condensable liquids was attributed mainly to a gain in natural gas produced and processed. As long-distance gas pipelines increased in number and capacity, the demand for the State's natural gas supplies increased in proportion. This increase required additional gas processing capacity, and the resulting gains in liquid recovery totals had an appreciable impact on fuels markets.

TABLE 10.—**Natural gas liquids production**

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	711,784	$55,976	294,662	$12,843	1,006,446	$68,819
1957	775,009	63,956	335,142	14,888	1,110,151	78,844
1958	783,099	50,371	410,869	21,435	1,193,968	71,806
1959	846,110	60,295	540,046	25,877	1,386,156	86,172
1960	875,567	66,214	606,023	28,147	1,481,590	94,361
1961	931,176	61,714	806,559	33,214	1,737,735	94,928

A 33-percent gain (12 percent in 1960) by LP gases represented most of the increased output of condensable liquids. This gain followed the trend of natural gasoline processors to recover more of the LP gas fractions of natural gas liquids, and then process the remaining heavier components to higher quality blending stocks for motor fuels. The LP gas consumption pattern in recent years has been more for chemical and fuel uses and less for blending into motor fuels at refineries.

To provide for rapid development and marketing of new gas supplies, the industry continued constructing vast facilities for processing natural gas and for recovering, delivering, and storing the plant liquids. Six plants were completed or expanded, and at least one plant was under construction. Union Oil Co. of California and Goliad Corp. put in operation their $13 million system for gas processing and liquid recovery. One plant at Cow Island in Vermilion Parish processed up to 450 million cubic feet of gas daily to recover 295,000 gallons of mixed liquids. The raw liquids were then delivered through an 88-mile pipeline to the Geismar fractionating plant a few miles south of Baton Rouge, where the hydrocarbon components were separated and supplied as charge stocks to the Monochem petrochemical complex established on the same site.

Continental Oil Co. completed a $2 million expansion of its Lake Charles processing plant, which increased the capacity from 100 million to 150 million cubic feet of gas per day.

Sunray Mid-Continent Oil Co. completed expansion of its Northwest Branch plant in Acadia Parish which processed gas from the Northwest Branch and Church Point fields. Gas-processing capacity was increased from 27 million to 50 million cubic feet per day; product capacity was approximately 88,000 gallons per day.

Union Texas Natural Gas Corp. completed its Sligo gas processing plant near Haughton, Bossier Parish. The plant had capacity to process 150 million cubic feet of gas daily and to recover approximately 125,000 gallons of natural gas liquids. The company also increased processing capacity of its Eunice plant to 800 million cubic feet of gas daily to accommodate added gas supplies. Product recovery was expected to be 857,000 gallons daily. A 10,000-horsepower gas-fired turbine was installed to drive the refrigeration compressors.

South Louisiana Production Co. installed a $50,000 refrigeration unit to double the recovery of plant liquids at its Jeanerette plant in St. Mary Parish. Gas processing capacity of the plant was increased to 25 million cubic feet daily.

In St. Bernard Parish, Shell Oil Co. started constructing the Yscloskу gas processing plant on the new Mississippi River-Gulf Outlet channel. The plant was designed to extract 10,000 barrels of liquids from 650 million cubic feet of gas daily from fields in lower Plaquemines Parish, including the big Bastian Bay field. Completion of the plant was scheduled for May 1, 1962.

Petroleum.—The petroleum industry in Louisiana established a new production record of 425 million barrels—second highest in the Nation. The gain of 6 percent over 1960 came from new discoveries both offshore and onshore. About 11 percent of the crude oil output was produced in north Louisiana, 65 percent in south Louisiana, and 24 percent in the offshore area, about the same distribution as in 1960.

To balance production with indicated demand, the State Conservation Commission continued to adjust petroleum allowables. Daily allowables, based on the Commission's formula, advanced from approximately 997,000 barrels at the first of the year to a peak of 1,034,000 barrels at midyear—largest allowable in the State's history. On July 1, the prevailing depth-bracket factor of the formula was lowered from 33 to 30 percent of the 1953 depth-bracket base, and the daily allowable was adjusted downward to 991,411 barrels. Despite this adjustment, new completions of producing wells increased at such a rate that by December both the daily allowable and actual production approximated the June figures.

TABLE 11.—Crude petroleum production
(Thousand barrels and thousand dollars)

Year	Quantity	Value
1952–56 (average)	263, 510	$751, 968
1957	329, 896	1, 094, 402
1958	313, 891	1, 023, 517
1959	362, 666	1, 145, 569
1960	400, 832	$1, 258, 138
1961 [1]	424, 962	1, 339, 905
1902–61	5, 940, 317	14, 245, 753

[1] Preliminary figures.

TABLE 12.—Crude petroleum production, indicated demand, and stocks, in 1961, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks (end of month)	Month	Production	Indicated demand	Stocks (end of month)
January	35,677	37,151	18,090	September	33,459	32,130	20,373
February	31,933	32,837	17,186	October	36,689	37,087	19,975
March	35,395	34,759	17,822	November	35,899	36,586	19,288
April	35,287	32,150	20,959	December	37,712	37,240	19,760
May	36,490	36,613	20,836				
June	35,525	35,694	20,667	Total:			
July	35,383	35,623	20,427	1961	424,962	424,766	----------
August	35,513	36,896	19,044	1960	400,832	398,615	----------

TABLE 13.—Number of producing oil wells and average production per well

Year	Number of producing wells Dec. 31	Average production per well per day (barrels)	Year	Number of producing wells Dec. 31	Average production per well per day (barrels)
1952–56 (average)	16,639	45.9	1959	23,468	42.7
1957	21,945	42.2	1960	24,682	44.8
1958	23,070	38.1	1961 [1]	24,740	47.1

[1] Preliminary figures.

For a number of years, the State Conservation Commission had been advocating unitized operations of leaseholds to promote secondary recovery of oil. As a direct result, the 100-percent required participation of interests was reduced to a 75-percent requirement, a boost to field development and conservation.

According to a survey,[5] Louisiana had 9,360 oil wells classified as stripper wells. For 1960, stripper wells represented 38 percent of total oil wells, but only 3 percent of the annual production and 4 percent of the State's recoverable oil reserves. Thus, normal production decline from stripper wells was not expected to affect appreciably the State's productive capacity and reserves in the immediate future.

Refineries.—At the beginning of 1961, there were 12 operating petroleum refineries and 1 inactive one in Louisiana. The crude oil capacity (barrels a day) was as follows: Operating, 789,550; standby, 8,500; and building, none. Cracked gasoline capacity (barrels a day) was as follows: Operating, 258,650; shutdown, 6,700; and building, 1,800.

Crude oil runs to refinery stills totaled 257 million barrels (about 6 percent more than in 1960) and represented about 60 percent of the annual production of crude oil.

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[5] Interstate Oil Compact Commission. National Stripper Well Survey, January 1, 1961, Oklahoma City, Okla., December 3, 1961.

TABLE 14.—Crude petroleum production by districts and fields

(Thousand barrels)

District and field [1]	1960	1961 [2]
Gulf Coast:		
Anse la Butte	1,687	1,565
Avery Island	3,089	2,985
Bateman Lake	2,694	3,538
Barataria	864	478
Bay de Chene	2,199	2,272
Bay Marchand	10,264	16,723
Bay St. Elaine	4,355	5,596
Bayou Blue	772	767
Bayou Choctaw	1,434	1,347
Bayou Mallet	812	800
Bayou Sale	3,948	5,387
Bully Camp	1,321	1,529
Caillou Island	17,040	17,634
Charenton	1,407	1,445
Cox Bay	1,391	1,932
Delta Farms	3,391	2,885
Dog Lake	738	711
Duck Lake	2,709	2,765
East White Lake	1,672	782
Egan	1,785	1,474
Erath	1,208	6,745
Garden Island	2,116	2,865
Gibson	913	968
Golden Meadow	2,355	2,363
Good Hope	983	937
Grand Bay	4,067	3,568
Grand Isle	3,819	5,516
Gueydan	1,119	1,003
Hackberry	5,251	4,413
Horseshoe Bayou	739	673
Iberia	886	672
Iowa	1,383	1,319
Jeanerette	1,170	1,074
Jennings	1,518	1,310
Lafitte	3,419	3,563
Lake Arthur	1,510	1,700
Lake Barre	5,340	6,438
Lake Chicot	730	732
Lake Fausse Point	1,577	1,407
Lake Pelto	4,571	4,551
Lake Salvador	2,310	2,238
Lake Washington	11,329	10,618
La Rose	975	925
Leeville	3,826	3,794
Little Lake	2,274	1,940
Lockport	780	692
Main Pass	11,110	11,194
North Crowley	838	1,170
Gulf Coast—Continued		
Paradis	2,732	2,701
Phoenix Lake	1,520	943
Pine Prairie	482	525
Point-a-la-Hache	1,360	1,311
Port Barre	877	834
Quarantine Bay	3,227	4,678
Romere Pass	2,736	3,086
St. Gabriel	585	603
Section 28	1,014	1,242
Shuteston	701	445
South Pass Block 24	11,120	15,671
South Pass Block 27	7,274	8,980
Tepetate	1,499	1,169
Timbalier Bay	11,996	11,860
University	435	518
Valentine	3,502	1,726
Venice	4,567	4,599
Ville Platte	810	859
Vinton	1,856	1,622
Weeks Island	8,397	9,538
West Bay	5,182	5,945
West Cote Blanche	4,375	4,559
West Delta, Block 30	6,799	8,809
West Lake Verret	1,263	1,328
White Castle	965	1,101
Other Gulf Coast	126,423	126,231
Total Gulf Coast	353,385	377,886
Northern:		
Big Creek	428	----------
Caddo	6,050	5,638
Cotton Valley	1,850	6,678
Delhi	5,144	5,097
Esperance Point	1,248	977
Haynesville	2,781	2,220
Lake St. John	1,569	2,923
Nebo	1,513	1,348
Olla	1,615	1,328
Rodessa	588	1,611
Sligo	1,388	1,434
Urania	837	770
Other Northern	22,436	17,052
Total Northern	47,447	47,076
Total Louisiana	400,832	424,962

[1] Breakdown for individual fields from the Oil and Gas Journal.
[2] Preliminary figures.

Tenneco Oil Co. (formerly Bay Petroleum Co.) began operating its new $8 million facilities at the Chalmette refinery. These facilities included a 6,000-barrel-a-day catalytic reformer, a 2,000-barrel-a-day extraction unit, and fractionators to recover aromatic chemicals as described under Petrochemicals.

Murphy Corp. (formerly Ingram Oil & Refining Co.), at Meraux, St. Bernard Parish, was increasing fluid catalytic cracking capacity from 6,500 to 7,500 barrels per day and polymerization capacity from 370 to 794 barrels per day. Completion was scheduled for April 1962.

Chemoil Corp. planned to build a 40,000-barrel-a-day refinery between New Orleans and Baton Rouge. The refinery was to include facilities to recover ethylene and propylene hydrocarbons.

The Clark Oil & Refining Corp. refinery at Marrero, Jefferson Parish, remained shut down.

TABLE 15.—Crude petroleum production and estimated reserves in Louisiana offshore area

(Thousand barrels)

Offshore area	Number of wells		1960	1961		
	1960	1961	Crude petroleum	Crude petroleum	Cumulative total	Estimated reserve
Bay Marchand: Block 2 [1] [2]	276	414	9,858	16,723	58,879	141,121
Belle Isle [2]	30	56	880	1,397	7,797	27,203
Caillou Island [1] [2]	472	551	16,694	17,634	177,356	122,644
Eugene Island:						
Block 18	55	56	2,482	2,764	9,218	30,782
Block 32	17	29	889	945	7,118	17,882
Block 100	-----	20	-----	1,111	1,120	18,880
Block 110	-----	16	-----	461	857	15,143
Block 126 [1]	79	90	3,176	3,248	23,962	101,038
Block 128	47	50	2,063	2,054	9,109	30,891
Block 188	20	18	1,026	927	2,822	12,178
Block 208	-----	39	-----	1,325	1,575	33,425
Grand Isle:						
Block 16	87	131	3,819	5,516	14,688	50,312
Block 18	37	40	1,813	1,951	14,986	25,014
Block 47	68	68	3,974	3,760	13,790	46,210
Lake Washington [1] [2]	341	373	10,863	10,618	73,820	136,180
Main Pass:						
Block 46	-----	6	-----	368	910	5,090
Block 69 [1]	182	188	7,305	7,227	52,684	147,316
Ship Shoal:						
Block 28	-----	4	-----	563	564	3,436
Block 107	-----	24	-----	866	866	17,134
Block 154	37	40	1,565	1,483	7,660	32,340
Block 176	16	16	682	859	1,541	10,459
South Pass:						
Block 24 [1] [2]	525	546	16,528	15,671	158,289	128,711
Block 27 [1]	198	255	7,274	8,980	30,082	119,918
Tiger Shoal	-----	12	-----	513	758	8,242
Timbalier Bay [1] [2]	318	366	11,695	11,860	68,427	131,573
South Timbalier: Block 131	14	12	697	517	1,574	10,426
Vermilion:						
Block 14	-----	13	-----	940	1,147	10,853
Block 120	12	(3)	389	(3)	(3)	(3)
West Cameron:						
Block 45	15	36	2,449	985	3,630	21,370
Block 192	-----	40	-----	550	1,014	18,986
West Delta:						
Block 24	-----	9	-----	416	517	7,483
Block 30 [1]	174	209	7,444	8,809	31,285	98,715
Block 53 [2]	13	12	817	798	5,966	16,034
Total	3,033	3,739	114,382	131,839	784,011	1,596,989

[1] Estimated ultimate recovery of 100 million barrels or more.

[2] Combined onshore and offshore.

[3] Not reported.

Source: Oil and Gas Journal, v. 60, Jan. 29, 1962, pp. 130–131.

Cities Service Petroleum Co. began constructing the first hydrocracking plant in the free world at its Lake Charles refinery. The plant was designed to convert residual oils with high sulfur content into a synthetic sweet crude oil equivalent. The process plant, known as an "H-oil" unit, with a designed initial capacity of 2,500 barrels of oil daily, was scheduled to go on stream late in 1962.

In the H-oil process, heavy, high-boiling-point residuum is reacted with hydrogen in the presence of an active catalyst to remove sulfur, nitrogen, and organo-metallic compounds, and to simultaneously upgrade the stock treated. The treated oil then is used as feedstock for processing into lighter petroleum products such as gasoline, heating oil, and diesel fuel.

The inventors of the H-oil process claimed that in producing areas such as the Middle East and Venezuela, where low-cost natural gas is available in quantity to manufacture hydrogen cheaply, application of the H-oil process to improve poor quality crude oils at the source was technically and economically feasible.

The trend in larger refineries was to install additional facilities to recover byproducts, especially olefins and aromatics to manufacture petrochemicals. Refiners who added or were adding substantial petrochemical capacity during the year were Tenneco Oil Co. at Chalmette, Humble Oil & Refining Co. at Baton Rouge, and Cities Service Co. and Continental Oil Co. at Lake Charles.

At Shreveport, Universal Oil Products Co. announced a $4.2 million expansion to its Caddo Parish plant, which manufactured special catalysts for petroleum refinery processes. The new addition was expected to employ approximately 50 workers.

Petrochemicals.—Petrochemicals made up one-third of the Nation's entire chemical output in 1961 and could reach 50 percent by 1970, according to the American Petroleum Institute. Total investment in the U.S. petrochemical industry exceeded $6 billion in 1961 and was rising rapidly. The Manufacturing Chemists' Association reported that petrochemical industry outlays in 1960 totaled $3.5 billion and that $278 million of this amount was spent in Louisiana, making it second to Texas in funds allocated for chemical project construction.

The petroleum branch of the chemical industry continued to lead the way in number of plant constructions, both new and planned. According to a petrochemical survey by The Oil and Gas Journal (December 4, 1961), there were 85 projects in the United States, and of these, 11 were in Louisiana. Growing competition in both domestic and foreign petrochemical markets caused the Gulf Coast segment of the industry to place more emphasis on market development. Although production of ammonia, ethylene, and aromatics remained high, the largest producers of these materials, the oil companies, were developing plant capacity to manufacture polyolefins, intermediates that contain other components such as chlorine and sulfur, and end products—thus captively using a large part of the basic materials.

A considerable number of the new plants and expansions were situated in the Gulf Coast area from Brownsville, Tex., to New Orleans and Baton Rouge, La. Leading petrochemical producers in this area expanded along the Gulf Coast because of nearby and readily available supplies of raw materials from refineries and gasfields; plentiful supplies of cheap natural gas for fuel; ample supplies of fresh water, sulfur, salt, and lime; and ready access to water transportation for the plant products either by oceangoing tanker or river barge. Also, many of these plants were dependent on other local plants for interchange of raw materials and byproducts.

Although petroleum refiners and chemical manufacturers started the industry, substantial petrochemical investments in recent years also were made by rubber processors, shipping interests, metal refiners, steel companies, farm equipment manufacturers, and dairy products firms. Most major oil companies with a strong position in foreign oil also were developing a strong position in foreign petrochemicals.

Louisiana chemical producers in 1961 completed 8 projects (new plants and expansions) and announced plans for 12 new projects.

At Lake Charles, Calcasieu Parish, Continental Oil Co. completed its $11 million ALFOL plant to manufacture industrial alcohols from ethylene. Planned capacity was 50 million pounds a year of primary alcohols for use in manufacturing detergents, plastics, cosmetics, and textiles.

Ancon Chemical Co. (a joint venture between Continental Oil Co. and Ansul Chemical Corp. of Marinette, Wis.) announced plans to construct a $1 million plant at Lake Charles to produce 60 million pounds of methyl chloride annually. The chemical is used to manufacture butyl rubber, tetramethyl lead, silicones, methyl cellulose, and ammonia compounds. Plant completion was scheduled for early 1962, and output was to be distributed by Ansul Chemical Co.

Cities Service Petroleum Co. put on stream its orthoxylene unit at its Lake Charles refinery and started constructing a propylene unit that was to be completed in late 1962 or early 1963. The completed plant would be capable of producing 120 million pounds per year of high-purity orthoxylene, a chemical used to manufacture synthetic resins, plasticizers, pharmaceuticals, and dyes. The company also announced its merger with Columbian Carbon Co., an operator of carbon black plants in North Bend and Eunice, and a partner with other petrochemical producers in the Gulf Coast region. The merger was reported to have enabled both companies to make progress in planned diversification programs.

Hercules Powder Co. began constructing a second plant at its Lake Charles site, to produce 60 million pounds of polyethylene or polypropylene per year. These chemicals were to be used to manufacture film, automobile seat covers, webbing, and molded plastic items. This second plant was scheduled for completion in the fall of 1962, and would bring the total cost for the two plants to $30 million.

Pittsburgh Plate Glass Co. (formerly Columbia-Southern Chemical Co. at Lake Charles) completed an ethylene dichloride unit in 1960 at its Lake Charles plant and announced plans for a new sodium chlorate unit and a new triethane unit. The sodium chlorate was to be used to manufacture chlorine dioxide; the triethane was to be used in drycleaning.

The Lake Charles Association of Commerce reported that Petroleum Chemicals, Inc., had spent $4.5 million since 1958 improving its ethylene and ammonia plants at Lake Charles and planned to spend $1.5 million on ethylene expansion through 1964.

At Chalmette, Tenneco Oil Co., subsidiary of Tennessee Gas Transmission Co., began operating, in conjunction with its oil refinery, an $8 million plant capable of producing 22 million pounds of orthylene and 20 million pounds of ethylbenzene annually. These chemicals were used to manufacture plastics and used as solvents in paints, lacquers, and insecticides. The new facility marked the company's entry into the petrochemical industry.

American Cyanamid Co. at Avondale, Jefferson Parish, was constructing a new facility at its Fortier plant to produce 35 million pounds of methyl methacrylate monomer annually. The monomer, to be manufactured from the company's own hydrocyanic acid, was to be converted into plastics and artificial fibers. Plant completion was scheduled for 1963. The company also announced a $3 million addition to its anhydrous ammonia plant at the same site. Output of the plant, all from natural gas, included 100 million pounds a year of acrylonitrile, 150 tons daily of ammonia, and large quantities of hydrocyanic acid, acetylene, and ammonium sulfate.

Shell Chemical Co. at Norco, St. Charles Parish, was manufacturing ingredients for the world's first source of artificial hydrogen peroxide used by astronauts to stabilize flights into outer space. The plant, a producer of various petrochemicals, was being expanded to manufacture additional products.

Dow Chemical Co. at Plaquemine, Iberville Parish, announced plans to put into operation in 1962 a second polyolefin unit to produce polyethylene and polypropylene. The new $6 million facility was to employ about 60 more workers and would bring Dow's total investment in Louisiana to $110 million.

At Geismar, Ascension Parish, U.S. Rubber Co. and Borden Co. began constructing a $50 million three-plant petrochemical complex. When completed in 1962, the jointly owned first plant, known as Monochem, Inc., would produce annually 80 million pounds of acetylene and 150 millions pounds of vinyl chloride. This output was to be used by two individually owned plants to manufacture a variety of chemical products.

The Goliad Corp. started operating $15 million fractionation and gas extraction plants at Geismar and Kaplan. The facilities, jointly owned by Union Oil Co. of California and Goliad Corp. of Houston, Tex., recovered mixed natural gas liquids at the Kaplan plant and transmitted them by pipeline to the Geismar fractionator for separation of the hydrocarbon components. These feedstocks were supplied to the petrochemical complex at the Geismar site.

Naugatuck Chemical Division of U.S. Rubber Co. announced construction of a multimillion dollar chemical plant to adjoin Monochem, Inc., at Geismar. The plant, scheduled for completion in 1963, was to produce a special synthetic rubber.

Allied Chemical Corp. and Union Texas Natural Gas Corp. were to build a $40 to $60 million petrochemical plant at the Geismar site. The plant, scheduled for completion in 1963, was to produce olefins and aromatics for further processing by Allied Chemical Corp. Feedstock was to be supplied by the adjoining Union Texas Gas processing plant.

At its Baton Rouge oil refinery, Humble Oil and Refining Co. began constructing a $4 million facility (Aldox Project) to produce 30 million pounds yearly of oxo-alcohols. Completion was scheduled for 1962.

Polymer Chemical Division, W. R. Grace & Co., increased production of polyethylene plastics by 50 percent at its Baton Rouge plant.

Copolymer Rubber & Chemical Corp. completed a $5 million expansion to produce butadiene at its Baton Rouge plant. Butadiene is the principal ingredient for production of styrene-butyl rubber (SBR). The expansion increased the plant's rubber capacity from 95,000 to 133,000 long tons per year.

Ethyl Corp. completed a $500,000 methyl chloride unit at its Baton Rouge plant.

Crown Zellerback Corp. completed a $1.7 million chemical plant at Bogalusa, Washington Parish, to produce organic sulfur compounds.

NONMETALS

Kaiser Aluminum & Chemical Corp. was constructing a $6 million hydrogen fluoride and fluorocarbons plant at its Gramercy works. The plant will be adjacent to the $1.4 million aluminum fluoride plant under construction and will supply it with hydrogen fluoride. Hydrogen fluoride and fluorocarbons also will be marketed. Hydrogen fluoride is used in producing or processing petroleum, stainless steel, glass, uranium, and other products; fluorocarbons are used as refrigerants in air conditioners, refrigerators, and freezers, as propellants for aerosols, and in plastics manufacture. Completion of both plants was scheduled for late in 1962.

Barite.—Crude barite from Arkansas, Missouri, and foreign countries was ground in Louisiana for use as weighting material in oil well drilling fluids. Three grinding plants operated at New Orleans and one at Lake Charles. Output of ground barite was slightly more than in 1960; footage drilled for oil and gas in the State gained about 2 percent.

Cement.—Portland cement was produced in three plants; output declined for the second consecutive year and was 10 percent below that of 1960. The decline was attributed mainly to slow recovery in actual construction, even though total value of construction contracts awarded (table 4) gained 2 percent. Public works and nonresidential construction, the largest users of portland cement, both exhibited lagging recoveries from 1960.

Clays.—There was an overall 14-percent decline in miscellaneous clay produced. Clay used for lightweight aggregate, brick, and cement decreased 22 percent, 15 percent, and 4 percent, respectively, from 1960. This loss, like that in cement output, was attributed to lagging construction. Over 208,000 tons of clay was used to manufacture heavy clay products at 11 brick plants in 10 parishes. Norman Brick Co., in Bienville Parish, closed in 1961. Lightweight aggregate was produced at Alexandria, Rapides Parish; Erwinville, Point Coupee Parish; and north of Shreveport, Caddo Parish.

Gypsum.—Winn Rock, Inc., Winn Parish, mined crude gypsum for a retarder in portland cement; output was about 18 percent more than in 1960. National Gypsum Co. at Westwego and U.S. Gypsum Co. at New Orleans calcined imported crude gypsum and manufactured plaster, lath, and wallboard.

Bestwall Gypsum Co.'s new $6 million plant on the new Mississippi River-Gulf outlet in New Orleans began processing about 200,000 tons of imported gypsum a year to produce plaster, lath, and gypsum board.

Lime.—Lime production registered an apparent gain over that of 1960. Most of the increase resulted from inclusion of lime produced and used by papermills. These plants were not canvassed previously.

TABLE 16.—Shipments of portland cement to Louisiana consumers

Year	Louisiana (thousand barrels)	Change, percent	
		In Louisiana	In United States
1952–56 (average)	6,753		
1957	7,585	−11	−6
1958	8,048	+6	+6
1959	8,908	+11	+9
1960	8,007	−10	−7
1961	7,865	−2	+3

TABLE 17.—Miscellaneous clay sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	629	$734	1959	904	$904
1957	642	642	1960	749	749
1958	755	755	1961	645	645

Approximately 66 percent of the production was used by chemical plants, 32 percent by paper plants, and only 2 percent by the building trade. Lime was made mostly from shell by 6 paper plants, 2 chemical plants, and 2 lime plants in 10 parishes. Lime producers for the open market were U.S. Gypsum Co. at New Orleans and the new plant of Pelican State Lime Co. at Morgan City.

Nitrogen Compounds.—Air Reduction Sales Co. operated its new $2 million air separation plant at the old Ronaldson airport near Baton Rouge. The plant had a daily production capacity of 30 tons of liquid oxygen, nitrogen, and argon for industrial uses.

Salt.—Output of salt declined slightly from 1960 because less was produced and consumed by chemical plants, but total value increased more than $1 million. Evaporated and/or rock salt were produced by five salt companies; brine was produced by six chemical companies.

TABLE 18.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	3,194	$12,240	1959	4,807	$20,918
1957	3,461	18,944	1960	4,792	21,959
1958	3,442	18,960	1961	4,722	23,357

TABLE 19.—Salt production, by types

(Thousand short tons and thousand dollars)

Type	1958		1959		1960		1961	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Evaporated salt	131	$2,959	168	$4,279	191	$4,737	196	$4,430
Rock salt	1,349	9,729	1,601	10,959	1,730	12,097	1,770	12,884
Brine	1,962	6,272	3,038	5,680	2,871	5,125	2,756	6,043

Responding to the growing demand for a variety of chemicals from salt used by the paper and chemical industries, Morton Chemical Co. completed a $3.4 million installation to replace older facilities at Weeks Island. The plant produced sodium sulfate and muriatic (hydrochloric) acid. The company also announced plans to build a multimillion dollar plant at Geismar, Ascension Parish, to supply chlorine and other chemicals from salt to the huge petrochemical complex at that site.

The tremendous reserves of salt in Louisiana's many salt domes, both inland and coastal, continued to attract the attention of salt producers, especially because of favorable orientation of these reserves to water transportation and to markets. In 1961 mines were being developed in two of the coastal salt domes.

At the Cote Blanche Island salt dome in St. Mary Parish, Carey Salt Co. (with Monsanto Chemical Co.) began sinking a shaft. The dome, at a depth of 564 feet, is located in the marsh north of West Cote Blanche Bay and is bounded on the north by the Intercoastal Canal. Carey planned to produce rock salt at the rate of 300 tons per hour.

At the Belle Isle salt dome, also in St. Mary Parish, Cargill, Inc., a Minneapolis farm products firm, was drilling a 1,300-foot shaft and installing a hoisting system capable of handling 400,000 tons of crushed rock salt annually. To sink the shaft, Cargill engineers devised a plan to freeze a vertical core of the earth 40 feet in diameter to enable the shaft to be dug into muddy earth without the ground collapsing. Walls of the shaft were then lined with reinforced concrete as work progressed. The salt was to be crushed, processed, screened, and packaged underground. Belt conveyers capable of loading two barges at a time were being installed on the surface.

Sand and Gravel.—Production of 12 million tons of sand and gravel, 16 percent less than in 1960, reflected the lag in construction activity that also was indicated by less cement output. Washed sand and gravel was 11.6 million tons, 96 percent of the total. Sand use for commercial operations was as follows: Building sand, 50 percent; paving sand, 45 percent; other construction and miscellaneous sand, 1 percent; and fill sand, 4 percent. Gravel use was as follows: Paving gravel, 50 percent; building gravel, 46 percent; and other construction and fill gravel, 4 percent. There were 114 producers of sand and gravel in 24 parishes.

TABLE 20.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	8,178	$10,132	242	$102	8,420	$10,234
1957	12,477	14,659	102	70	12,579	14,729
1958	14,610	16,982	451	137	15,061	17,119
1959	15,505	19,898	547	213	16,052	20,111
1960	13,935	18,990	384	116	14,319	19,106
1961	11,783	14,729	259	104	12,042	14,833

TABLE 21.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,064	$2,271	2,134	$1,997
Paving	2,019	2,248	1,905	1,905
Fill	120	65	174	91
Other [1]	504	733	22	20
Total	4,707	5,317	4,235	4,013
Gravel:				
Building	3,289	4,107	3,466	4,527
Paving	5,244	8,759	3,783	5,833
Fill	271	323	(2)	(2)
Other [3]	424	484	299	356
Total	9,228	13,673	7,548	10,716
Total sand and gravel	13,935	18,990	11,783	14,729
Government-and-contractor operations:				
Gravel:				
Building	264	80	157	63
Paving	120	36	102	41
Total gravel	384	116	259	104
Grand total	14,319	19,106	12,042	14,833

[1] Includes glass, molding, filtering, and other construction and industrial sands.
[2] Included with other.
[3] Includes railroad ballast and fill gravel.

TABLE 22.—Sand and gravel production in 1961 by parishes

Parish	Short tons	Value	Parish	Short tons	Value
Bossier	90,000	$36,000	Rapides	1,030,304	$1,174,137
Caddo	115,000	96,000	Red River	59,339	128,381
E. Baton Rouge	456,496	389,185	St. Tammany	518,055	367,880
Iberia	4,308	1,723	Tangipahoa	773,892	481,085
LaSalle	140,421	132,593	Washington	710,847	496,752
Lincoln	156,923	62,769	W. Feliciana	832,500	1,259,400
Livingston	89,889	64,707	Other Counties [1]	5,964,675	7,708,314
Ouachita	1,099,066	2,433,813			
			Total	12,041,715	14,832,739

[1] Includes Allen, Beauregard, Catahoula, East Feliciana, Evangeline, Grant, Jefferson Davis, Lafayette, St. Helena, and Webster Parishes, combined to avoid disclosing individual company confidential data.

Owens-Illinois Glass Co. started production in June in what was called the "world's most highly automated glass container plant," built on the Industrial Canal in New Orleans. Raw materials were automatically measured, mixed, melted, and molded. When in full production, the $3 million plant would use 55,000 tons of raw materials annually to produce 100 million glass containers of various sizes.

Approximately 1.8 million yards of sand (hydraulic fill) was used at the New Orleans airport to extend the runway 2,000 feet in an area formerly covered by Lake Pontchartrain. The fill was dredged from a depth of 80 feet in the lake.

Gifford Hill & Co., Inc., at Shreveport, purchased Meriwether Supply Corp., a producer of sand and concrete products, and began a $180,000 expansion of operations for production of sand and concrete products.

Stone.—Most of the stone produced was shell (clam and oyster). A small quantity of miscellaneous stone was produced in Winn Parish for road surfacing and concrete. Lacking an adequate supply of stone, Louisiana relied on shell as a substitute. Seventy-two percent of the shell was used for concrete aggregate and road construction; 13 percent was used as a cement raw material; 14 percent was burned to lime; and 1 percent was used as paint filler, rubber filler, and mineral food. Total output of shell was virtually unchanged from 1960. Winn Rock, Inc., at Winnfield, announced plans to build an asphalt-filler rock plant.

Sulfur.—Shipments and apparent consumption of Frasch sulfur reached a record high in 1961. Byproduct sulfur was recovered from refinery operations at Lake Charles and Baton Rouge. Domestic sales by the entire industry increased 8 percent because of a gain in the national economy and increased changeover from dry shipments to liquid deliveries to customers. Increased sulfur output in Louisiana was attributed mainly to the first complete year of operation of the big offshore mine in the Gulf of Mexico.

Imports of sulfur into the United States from Mexico and Canada were estimated at 965,000 tons, an increase of 80,000 tons over the 1960 total. Exports for the year were off 12 percent due to encroachment in world sulfur markets by other countries coupled with a decline in European markets.

In the United States, higher sulfur consumption was reported by the chemical, rayon, and pigment industries. Demand by the paper and steel industries remained steady, whereas unfavorable spring weather caused a drop in demand in the fertilizer industry.

TABLE 23.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments		Year	Production	Shipments	
		Quantity	Value			Quantity	Value
1952–56 (average)	1,934	1,845	$48,410	1959	2,035	2,252	$52,779
1957	2,125	2,156	52,690	1960	2,264	2,256	52,639
1958	2,055	2,028	47,651	1961	2,608	2,352	55,164

Freeport Sulphur Co. announced that it would add a 1,500-foot extension to the Grand Isle offshore mine platform to bring the total length to 4,076 feet. The project, 7 miles offshore in 50 feet of water, withstood hurricane Carla in 1961. The new extension will permit drilling 108 additional wells and will raise the total expenditures for the project to $30 million. Completion was expected in 1963.

Freeport Sulphur Co. began long-distance shipments of sulfur in liquid form to points on inland waterways. The company announced that shipment of molten sulfur would be made to Atlantic seaboard ports as far north as Maine as soon as additional storage facilities were available. Freeport planned to ship, in liquid form, more than half the sulfur from its terminal at Port Sulphur. New storage and handling terminals were being constructed on the Mississippi River and on the Atlantic coast, and new storage facilities are under construction at Port Sulphur to handle additional quantities of molten sulfur. Shipments upriver were made in insulated barges; a T–2 type tanker was being converted to handle coastal shipping. Shipments to foreign countries were to continue to be made in dry form.

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. produced alumina at its Gramercy and North Baton Rouge plant. The alumina from these two plants was then transported downstream to the firm's aluminum works at Chalmette for reduction to primary aluminum. At its Gramercy works, Kaiser was building a $1.4 million aluminum fluoride plant. (See opening paragraph under Nonmetals for details.)

At its Baton Rouge alumina plant, Kaiser put into operation a $700,000 facility to produce activated alumina in uniform spherical shape. The material serves as a catalyst in various chemical processes.

During the early part of the year, Kaiser's Chalmette plant operated six of nine potlines, about 60 percent of capacity, to adjust plant inventories of primary aluminum. In May, two additional potlines were reactivated, leaving one idle, and approximately 350 workers were recalled. This reopening brought the company's overall aluminum production to about 75 percent of capacity. Later in the year, the company announced plans to reactivate the last potline and raise production to 90 percent of capacity. At full production, the Chalmette plant employed about 2,400 persons. Chalmette was the largest primary aluminum plant in the United States.

Iron Ore.—The Louisiana Geological Survey was investigating iron ore deposits in Claiborne and Union Parishes. The deposits, identified as siderite and limonite, are bedded deposits exposed in hillsides similar to deposits in East Texas. A report of the investigation was to be completed in 1962 and was expected to contain a map of the deposits and estimates of reserves of each type of ore.

REVIEW BY PARISHES

Minerals were produced in all but 1 of the State's 64 parishes. Mineral fuels were produced in 58 parishes; other minerals were produced in 41 parishes. Five parishes reporting mineral production valued at over $100 million (same in 1960) were: Plaquemines, $415 million; Terrebonne, $223 million; Lafourche, $216 million; St. Mary, $144 million; and Cameron, $113 million. Four parishes reporting output between $100 million and $50 million (same in 1960) were: Vermilion, $99 million; Acadia, $97 million; Iberia, $85 million; and Jefferson, $80 million. Forty-four other parishes reported mineral production valued at over $1 million.

Acadia.—Exploratory drilling of 33 wells for petroleum and natural gas proved 24-percent productive; 63 percent of the 54 development wells drilled were productive. About 160 crew-weeks were spent in geophysical prospecting. The parish again ranked first in the production of natural gas liquids; this output was valued at $27.3 million. Natural gas liquids were recovered by six plants.

Runnels Gas Products Co. completed a $7 million expansion of its Eunice plant to recover hydrocarbon components. Sunray Mid-Continent Oil Co. expanded its Northwest Branch plant to process gas from the Northwest Branch and Church Point fields. Production capacity was increased to 88,000 gallons per day.

TABLE 24.—Value of mineral production in Louisiana, by parishes[1]

Parish	1960[2]	1961	Minerals produced in 1961 in order of value
Acadia	$93,555,024	$97,184,070	Petroleum, natural gas, natural gas liquids.
Allen	9,222,987	8,919,937	Petroleum, natural gas, natural gas liquids, lime, sand and gravel.
Ascension	1,817,246	2,295,286	Petroleum, natural gas, salt.
Assumption	20,164,795	21,284,663	Petroleum, natural gas.
Avoyelles	1,914,263	1,778,325	Petroleum, natural gas liquids, natural gas.
Beauregard	17,549,995	15,734,621	Petroleum, natural gas, natural gas liquids, sand and gravel.
Bienville	8,228,171	8,016,557	Natural gas, petroleum.
Bossier	32,060,864	33,012,772	Natural gas, petroleum, natural gas liquids, sand and gravel.
Caddo	34,090,393	31,562,541	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Calcasieu	44,095,170	39,310,348	Petroleum, natural gas, cement, natural gas liquids, lime, salt, sulfur, clays.
Caldwell	583,127	934,672	Natural gas, petroleum.
Cameron	114,562,227	112,919,684	Natural gas, petroleum, natural gas liquids, salt.
Catahoula	5,418,867	5,851,036	Petroleum, sand and gravel, natural gas.
Claiborne	26,724,994	25,734,404	Petroleum, natural gas, natural gas liquids.
Concordia	14,947,563	13,118,864	Do.
De Soto	11,877,814	11,147,375	Natural gas, petroleum, natural gas liquids.
East Baton Rouge	13,988,496	12,175,061	Cement, petroleum, lime, sand and gravel, natural gas, natural gas liquids, clays.
East Feliciana	(3)	(3)	Sand and gravel.
Evangeline	10,835,546	10,669,000	Petroleum, natural gas, natural gas liquids, sand and gravel.
Franklin	2,626,924	2,226,507	Petroleum, natural gas.
Grant	803,699	(3)	Petroleum, sand and gravel.
Iberia	84,715,144	85,368,032	Petroleum, natural gas, salt, natural gas liquids, clays, sand and gravel.
Iberville	26,991,898	27,760,335	Petroleum, salt, natural gas.
Jackson	39,694	305,816	Lime, natural gas, petroleum.
Jefferson	66,785,704	79,775,154	Petroleum, sulfur, natural gas, natural gas liquids, shell.
Jefferson Davis	43,580,114	47,681,768	Natural gas, petroleum, sand and gravel, natural gas liquids.
Lafayette	4,230,191	8,627,768	Petroleum, natural gas, sand and gravel, clays.
LaFourche	187,318,614	215,612,308	Petroleum, natural gas, sulfur, natural gas liquids.
La Salle	17,583,824	17,427,514	Petroleum, natural gas, sand and gravel.
Lincoln	22,311,546	20,415,326	Natural gas, natural gas liquids, petroleum, sand and gravel, clays.
Livingston	290,092	226,569	Petroleum, sand and gravel, natural gas.
Madison	1,276,091	1,148,905	Petroleum, natural gas.
Morehouse	1,628,207	2,689,775	Natural gas, lime, petroleum.
Natchitoches	378,984	310,648	Petroleum, clays, natural gas.
Orleans	(3)	(3)	Cement, lime.
Ouachita	9,423,238	9,313,167	Natural gas, sand and gravel, petroleum, lime, clays, natural gas liquids.
Plaquemines	399,419,615	415,170,624	Petroleum, natural gas, sulfur, natural gas liquids.
Pointe Coupee	7,751,568	6,908,287	Petroleum, natural gas, natural gas liquids, clays.
Rapides	1,946,575	1,978,093	Sand and gravel, petroleum, natural gas, clays.
Red River	874,751	1,043,521	Petroleum, sand and gravel, natural gas.
Richland	16,514,539	15,569,920	Petroleum, natural gas liquids, natural gas.
Sabine	518,437	1,460,163	Petroleum, natural gas.
St. Bernard	2,856,920	3,047,526	Natural gas liquids, petroleum, natural gas.
St. Charles	35,669,318	38,917,491	Petroleum, natural gas, natural gas liquids.
St. Helena	(3)	(3)	Sand and gravel.
St. James	4,560,459	3,923,295	Petroleum, natural gas.
St. John the Baptist	3,755,476	3,511,198	Do.
St. Landry	40,699,289	45,742,527	Petroleum, natural gas, natural gas liquids.
St. Martin	48,467,709	48,951,371	Petroleum, natural gas, salt, natural gas liquids.

See footnotes at end of table.

TABLE 24.—Value of mineral production in Louisiana, by parishes [1]—Continued

Parish	1960 [2]	1961	Minerals produced in 1961 in order of value
St. Mary	$122,643,737	$143,805,799	Petroleum, natural gas, shell, natural gas liquids, lime.
St. Tammany	2,116,048	1,533,050	Shell, sand and gravel, natural gas, petroleum, clays.
Tangipahoa	542,253	543,102	Sand and gravel, petroleum, clays.
Tensas	15,009,745	14,895,284	Petroleum, natural gas liquids, natural gas.
Terrebonne [4]	199,814,795	222,782,013	Petroleum, natural gas, sulfur, natural gas liquids.
Union	9,529,574	11,548,009	Natural gas, petroleum.
Vermilion	81,645,985	99,113,160	Natural gas, petroleum, natural gas liquids.
Vernon	----------	3,031	Petroleum, natural gas.
Washington	566,872	(3)	Lime, sand and gravel.
Webster	33,837,530	32,224,341	Petroleum, natural gas, natural gas liquids, lime, sand and gravel.
West Baton Rouge	1,103,297	1,129,995	Petroleum, natural gas, clays.
West Carroll	373,714	306,933	Natural gas.
West Feliciana	(3)	1,259,400	Sand and gravel.
Winn	3,215,278	5,510,813	Petroleum, salt, stone, gypsum, natural gas.
Undistributed	22,912,010	82,024,246	
Total	1,987,967,000	2,173,442,000	

[1] East Carroll not listed because no production was reported.
[2] Revised figures.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[4] Terrebonne Parish sulfur shipments included with Plaquemines Parish in 1960.

Ascension.—At Geismar, U.S. Rubber Co. and Borden Co. jointly began construction of a $50 million three-plant petrochemical complex. When completed in 1962, the jointly owned first plant, known as Monochem, Inc., was to produce annually 80 million pounds of acetylene and 150 million pounds of vinyl chloride. This output was to be used by the two individually owned plants to manufacture a variety of chemical products.

Goliad Corp. began operating its fractionation plant at Geismar. The facility, jointly owned by Union Oil Co. and Goliad Corp. of Houston, Tex., separated mixed natural gas liquids from the Kaplan plant (transmitted by pipeline) into hydrocarbon components. These products were supplied as feedstocks to the petrochemical complex at the Geismar site.

Naugatuck Chemical Division of U.S. Rubber Co. announced construction of a multimillion dollar chemical plant to adjoin Monochem, Inc., at Geismar. The plant, scheduled for completion in 1963, was to produce a special synthetic rubber.

Allied Chemical Corp. and Union Texas Natural Gas Corp. announced plans to build a $40 to $60 million jointly owned petrochemical plant, also at the Geismar site. The plant, scheduled for completion in 1963, was to produce olefins and aromatics for further processing by Allied Chemical Corp. Feedstock was to be supplied by the adjoining Union Texas gas processing plant.

Humble Oil & Refining Co. completed a sixth storage well to enlarge underground storage facilities of plant liquids in the Sorrento salt dome. Total storage capacity was raised to 1.8 million barrels. Also at the Sorrento dome, Shell Oil Co. began loading its 180,000-barrel storage cavity with natural gas liquids from its Norco refinery.

The Gonzales gasfield was discovered.

Beauregard.—Exploratory drilling resulted in discovery of the West Merryville gasfield. Natural gas liquids were recovered at four plants.

Bossier.—Natural gas liquids were recovered at five gas processing plants. Included was a newly completed plant of Union Texas Natural Gas Corp. This new plant, near Haughton, had capacity to process 150 million cubic feet of gas daily and to recover 125,000 gallons of plant liquids.

Caddo.—The parish ranked second in total number of oil and gas wells drilled—340 wells (283 in 1960). Natural gas liquids were recovered by 10 gas processing plants.

Caddo Light Aggregate Co., Inc., a subsidiary of Bayou State Oil Corp., mined clay to manufacture lightweight aggregate at its plant northwest of Shreveport. Gifford Hill & Co., Shreveport, announced purchase of Meriwether Supply Corp., a producer of sand and concrete products, and began at $180,000 expansion of operations.

Universal Oil Products Co. announced a $4.2 million expansion to its Shreveport plant, which manufactured special catalysts for petroleum refinery processes. The new addition was expected to employ approximately 50 workers.

Calcasieu.—The Lake Charles Industrial Complex comprised over a dozen large plants and was built to facilitate production and processing of crude petroleum, natural gas, natural gas liquids, cement, sulfur, lime, and salt. The complex was one of the most important in the State.

Exploratory drilling opened the Buhler oilfield.

At Lake Charles, Continental Oil Co. completed at yearend its $11 million ALFOL plant to manufacture industrial alcohols from ethylene. Planned capacity was 50 million pounds a year of primary alcohols for use in manufacturing detergents, plastics, cosmetics, and textiles.

Ancon Chemical Co. (a joint venture between Continental Oil Co. and Ansul Chemical Corp. of Marinette, Wis.), announced plans to construct a $1 million plant at Lake Charles to produce 60 million pounds of methyl chloride annually. Plant completion was scheduled for early 1962, and output was to be distributed by Ansul Chemical Co.

Cities Service Petroleum Co. put on stream its orthoxylene unit at the Lake Charles refinery and started constructing a propylene unit which was to be completed in late 1962 or early 1963. The completed plant would be capable of producing 120 million pounds per year of high-purity orthoxylene, a chemical used to manufacture synthetic resins, plasticizers, pharmaceuticals, and dyes. The company also announced its merger with Columbian Carbon Co., an operator of carbon black plants in North Bend and Eunice.

Hercules Powder Co. started constructing a second plant at its Lake Charles site to produce 60 million pounds of polyethylene or polypropylene per year. These chemicals are used to manufacture film, webbing, and molded plastic items. The second plant, scheduled for completion in the fall of 1962, will bring the total cost of both plants to $30 million.

Pittsburgh Plate Glass Co. (formerly Columbia-Southern Chemical Co. at Lake Charles), which completed an ethylene dichloride unit in 1960 at its Lake Charles plant, announced plans for a new sodium chlorate unit and a new triethane unit. Sodium chlorate is used to manufacture chlorine dioxide; triethane is used in drycleaning.

The Lake Charles Association of Commerce reported that Petroleum Chemicals, Inc., had spent $4.5 million since 1958 perfecting its ethylene and ammonia plants at Lake Charles and planned to spend $1.5 million on ethylene expansion through 1964.

Cities Service Petroleum Co. started constructing the first hydrocracking plant at its Lake Charles refinery. The process, known as "H-Oil," converts residual oils with high sulfur content into a synthetic sweet crude oil. Completion of the plant was scheduled for late 1962.

Cameron.—The parish again ranked fifth in total value of mineral production and first in value of natural gas. Exploratory drilling resulted in discovery of the Ocean View Beach gasfield, inshore, and the West Cameron Block 1 gasfield, offshore. Natural gas liquids were recovered by four gas processing plants.

Catahoula.—Drilling of 33 exploratory wells resulted in 5 productive oil wells and opening of the Kincaid oilfield; development drilling resulted in 25 oil wells and 47 dry holes.

Claiborne.—Natural gas liquids were recovered by four gas processing plants. Exploratory and development drilling resulted in 19 oil wells, 1 gas well, and 9 dry holes.

De Soto.—Drilling of 104 wells (124 in 1960) proved 40 oil wells and 24 gas wells. Test drilling resulted in discovery of the Hunter oilfield. Natural gas liquids were recovered by the South Keatchie plant of Jones O'Brien, Inc.

East Baton Rouge.—Construction of new facilities and expansion of existing facilities were reported in the Baton Rouge area, which contained one of the State's largest industrial complexes. Kaiser Aluminum & Chemical Corp. processed Jamaican bauxite into alumina at its North Baton Rouge plant. At its Baton Rouge oil refinery, Humble Oil & Refining Co. began constructing a $4 million facility (Aldox Project) to produce 30 million pounds yearly of oxo-alcohols. Completion date was scheduled for 1962.

Polymer Chemical Division, W. R. Grace & Co., increased production of polyethylene plastics by 50 percent at its Baton Rouge plant.

Copolymer Rubber & Chemical Corp. completed a $5 million expansion to produce butadiene at its Baton Rouge plant. Butadiene is used for production of styrene-butyl rubber (SBR). The expansion increased the plant's rubber capacity from 95,000 to 133,000 long tons per year.

Ethyl Corp. completed a $500,000 methyl chloride unit at its Baton Rouge plant.

Natural gas liquids were recovered by the Burtville plant of Shell Oil Co. Clay was mined by Acme Brick Co. to manufacture brick. Ideal Cement Co. produced portland, high-early-strength, and masonry cements from shell which was barged up the Mississippi River.

Evangeline.—Natural gas liquids were recovered by the Ville Platte plant of Continental Oil Co. and by the Mamou and Pine Prairie plants of Socony Mobil Oil Co.

Iberia.—The parish ranked first in salt production; more than a third of the salt came from three large mines. Natural gas liquids were recovered by the Shell Oil Co. Weeks Island plant. The South Marsh Island Block 48 and Eugene Island Block 205 gasfields were discovered offshore.

Iberville.—Klondike oilfield was discovered. Dow Chemical Co. at Plaquemine was to put into operation in 1962 a second polyolefin unit. The new $6 million unit would employ about 60 more workers.

Jefferson.—Freeport Sulphur Co. announced it would add a 1,500-foot extension to the Grand Isle offshore platform to bring the total length to 4,076 feet. The new extension would permit the drilling of 108 additional sulfur wells.

The parish ranked fifth in petroleum production; the output was valued at $65 million. Natural gas liquids were recovered by two gas processing plants.

American Cyanamid Co. was constructing a new facility at its Fortier plant to produce 35 million pounds of methacrylate monomer annually. Plant completion was scheduled for 1963. The company also announced a $3 million addition to its anhydrous ammonia plant at the same site.

Lafourche.—The parish ranked third in total value of minerals produced, second in crude oil produced, and fifth in natural gas output. Extensive exploration for petroleum (169 crew-weeks) and drilling of 27 exploratory wells resulted in 6 productive wells but no new fields. Natural gas liquids were recovered by the Lockport plant of Socony Mobil Oil Co. and the Valentine plant of Texaco, Inc.

Freeport Sulphur Co. used the Frasch process to mine sulfur at its Chacahoula mine.

Lincoln.—The parish, with three natural gasoline plants, ranked third in recovery of natural gas liquids; output was valued at $8.7 million. Ruston Brick Works mined clay at Ruston to manufacture brick.

Orleans.—New Orleans Public Service, Inc., continued construction of the 230,000-kilowatt generating unit at its Michoud Station. The installation, estimated to cost over $24 million, was scheduled for operation in the spring of 1963. Most of the barite ground in the State was from foreign ores and was processed in Orleans Parish by three companies. Alatex Construction Service, Inc., processed crude perlite from Western States into expanded perlite for use in acoustical plasters and concrete aggregate.

At New Orleans, U. S. Gypsum Co. manufactured quicklime and hydrated lime in its new lime plant adjacent to the company's gypsum products plant and fronting on the Inner Harbor Industrial Canal.

Bestwall Gypsum Co. operated its new gypsum lath and plaster products plant near New Orleans.

Owens-Illinois Glass Co. began production in June at its new $3 million multifurnace glass container plant situated on the Inner Harbor Industrial Canal.

Ouachita.—Acme Brick Co. mined clay at Monroe to manufacture brick and tile. Natural gas liquids were recovered by the Calhoun plant of Arkansas Louisiana Chemical Corp. The Cheniere gasfield was discovered by Southwest Natural Gas Producing Co.

Plaquemines.—The total value of mineral production in the parish, situated in the Mississippi River delta, increased from $399 million (revised) in 1960 to $415 million—highest in the State. The parish ranked first in production of crude petroleum and sulfur and fourth in natural gas. Geophysical prospecting amounted to 192 crew-weeks. The parish ranked third in total number of oil and gas wells drilled with 276 wells (270 in 1960). Bay Denesse oilfield and Bohemia gasfield were discovered onshore; Breton Sound Block 49 gasfield was discovered offshore. The parish had vast onshore and offshore reserves of petroleum and natural gas.

Natural gas liquids were recovered by four gas processing plants.

Rapides.—Three commercial sand and gravel producers operated during 1961. Clay was mined for producing lightweight aggregate by Louisiana Lightweight Aggregate Co. and for structural clay products by Acme Brick Co. Central Louisiana Electric Co. (CLECO) started operating a 229,000-kilowatt electric-generating station at Caughlin.

St. Bernard.—Natural gas liquids were recovered by two plants. Also, Shell Oil Co. started constructing its Ysclosky gas processing plant on the new Gulf Outlet channel. The plant, to be completed in 1962, was designed to extract 10,000 barrels of liquid from 650 million cubic feet of gas daily from fields in Plaquemines Parish.

Tenneco Oil Co. (formerly Bay Petroleum Co.) began operating its new facilities at the Chalmette refinery. These included a 6,000-barrel-a-day catalytic reformer, a 2,000-barrel-a-day extraction unit, and fractionators to recover petrochemicals.

Murphy Corp. (formerly Ingram Oil & Refining Co.) was increasing fluid cracking capacity from 6,500 to 7,500 barrels a day at its Meraux refinery. Completion was scheduled for April 1962.

The Kaiser Aluminum & Chemical Corp. Chalmette aluminum works operated six of nine potlines to May 1, when aluminum capacity was raised from 60 to 75 percent by reactivation of two additional potlines. Later in the year, the company announced plans to open the ninth potline. Approximately 350 workers were recalled.

St. James.—At Gramercy, Kaiser Aluminum & Chemical Corp. started constructing a $6 million plant to produce hydrogen fluoride and fluorcarbons. The new plant would supply hydrogen fluoride to the adjacent $1.4 million aluminum flouride plant, under construction. Completion of both plants was scheduled for late 1962.

St. Landry.—The parish ranked fifth in recovery of natural gas liquids; four recovery plants operated during 1961. South Louisiana Production Co. planned to put a new gas processing plant on stream in April 1962. The $1.5 million plant was to process up to 40 million cubic feet of gas daily to recover 50,000 gallons of liquid.

St. Mary.—The parish ranked fourth in total value of minerals and fourth in petroleum production and also produced appreciable quantities of natural gas, natural gas liquids, and shell.

South Louisiana Production Co. installed a $50,000 refrigeration unit to double the recovery of plant liquids at its Jeanerette plant. Geophysical prospecting totaled 147 crew-weeks during the year. EastAtchafalaya Bay gasfield was discovered onshore by Mississippi River Fuel Oil Corp.

In the Eugene Island area, Continental Oil Co. drilled an offshore well at a record distance of 78 miles from land in 180 feet of water. Although the well was dry, it provided valuable geologic information.

Two domes were being developed for salt production. At the Belle Isle dome, Cargill, Inc., a Minneapolis farm products firm, was drilling a 1,300-foot shaft and installing a hoisting system capable of lifting 400,000 tons of crushed rock salt annually. At Cote Blanche Island dome, Carey Salt Co. was sinking a 564-foot shaft and proposed to use operating equipment rated at 300 tons per hour to produce rock salt. Barge hauling was to be used to transport the salt up inland waterways.

Tensas.—Exploratory drilling of 22 wells proved 6 oil wells and 1 gas well. These discovery wells opened three new fields—Hard Bargain and Cow Slough oilfields and Crimea gasfield.

Terrebonne.—The parish ranked second in total value of minerals produced, second in natural gas production, third in petroleum production and fourth in the number of wells drilled for exploration and development of petroleum and natural gas. Exploratory drilling resulted in discovery of Bay LeFleur and Southwest Bourg gasfields and Trinity Bayou oilfield onshore, and Ship Shoal Area Block 186 gasfield offshore. Tennessee Gas Transmission Co. purchased large gas and oil holdings in Blocks 198 and 199, Ship Shoal area, offshore. The acquisition contained an estimated 533 billion cubic feet of gas and 16 million barrels of oil. Natural gas liquids were recovered by four plants—Shell Oil Co. (two plants), Texaco, Inc., and Tidewater Oil Co. Freeport Sulphur Co. mined sulfur by the Frasch process from its Lake Pelto Mine, opened in 1960.

Vermilion.—The parish ranked third in value of natural gas and second in value of natural gas liquids. Exploratory drilling resulted in the discovery of Vermilion Block 16 and Vermilion Block 129 gasfields, offshore.

Natural gas liquids were recovered by four gas processing plants. One of these plants (Cow Island) supplied mixed liquids by pipeline to the Goliad Corp. Riverside fractionator at Geismar on the Mississippi River. At Geismar, the hydrocarbon components from the fractionator were supplied at feedstock to the petrochemical plants.

Webster.—The parish ranked fourth in value of natural gas liquids recovered. These products were recovered by the Cotton Valley plant of Cotton Valley Operators and the Bistineau plant of Arkansas-Louisiana Chemical Corp. Lime was produced at the Springhill plant of International Paper Co. for plant use.

Winn.—Extensive drilling of 371 wells, largest number in the State, proved 143 field-development oil wells and 3 exploratory oil wells. No new fields were discovered.

Winn Rock, Inc., at Winnfield, mined about 18 percent more crude gypsum than in 1960. The firm also announced construction plans for an asphalt-filler rock plant.

The Mineral Industry of Maine

This chapter has been prepared under a cooperative agreement for collecting mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Maine.

By Robert W. Metcalf[1] and Mary E. Otte[2]

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THE VALUE of mineral output in Maine again rose to a new peak, $15 million, 9 percent above the record set in 1960. A heavy demand for architectural dimension granite and substantially increased production of portland and masonry cements were contributing factors. The output of clays and beryllium concentrates also increased. Sand and gravel output declined moderately; production of mica and feldspar dropped sharply.

The Maine Department of Economic Development sponsored a study by Armour Research Foundation of Maine's basic raw material resources, and the possibilities of developing new or expanding existing manufacturing industries in the State.[3]

Prospecting and exploration in Maine for base metals and other minerals continued by Federal and State agencies and private firms. Additional geologic mapping was done by the State and the Federal Geological Survey, and geophysical, aeromagnetic, and gravity surveys were undertaken by public and private agencies. Drilling programs were particularly active. One firm spent about $1 million in exploration and drilling for nickel. At least six companies were drilling for copper and other base metals in various parts of the State. Asbestos exploration and diamond drilling in greenstone formations continued for a second year in northwestern Maine.

Of special significance from the standpoint of future exploration and drilling in Maine were the working agreements reached between the large landowning paper companies and the mining companies desiring to prospect and develop the potential mineral resources. This should lead to increased exploration in the future.

Legislative and Government Programs.—Beryl and mica were purchased for the national stockpile through the General Services Administration (GSA) purchase depots at Franklin, N.H., (beryl and mica), Spruce Pine, N.C. (mica), and Custer, S. Dak. (mica).

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[2] Statistical clerk, Bureau of Mines, Pittsburgh, Pa.

[3] Armour Research Foundation. Planning Study for the Economic Growth of Maine, 1961. Small Business Administration Management Res. Summary, April 1961.

TABLE 1.—Mineral production in Maine [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrates.....short tons..	(2)	(2)	5	$3
Clays.....thousand short tons..	41	$50	43	51
Gem stones.....	(3)	15	(3)	20
Mica:				
Scrap.....short tons..	171	6	80	2
Sheet.....pounds..	26,842	[4] 303	7,373	88
Sand and gravel.....thousand short tons..	9,833	3,892	8,921	3,796
Stone.....do....	1,012	3,851	998	4,694
Value of items that cannot be disclosed: Cement (masonry and portland), feldspar, and values indicated by footnote 2.....	.....	[4] 5,991	.....	6,961
Total: Maine [5].....	.....	[4] 13,677	.....	14,969

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Weight not recorded.

[4] Revised figure.

[5] Total adjusted to eliminate duplicating value of stone.

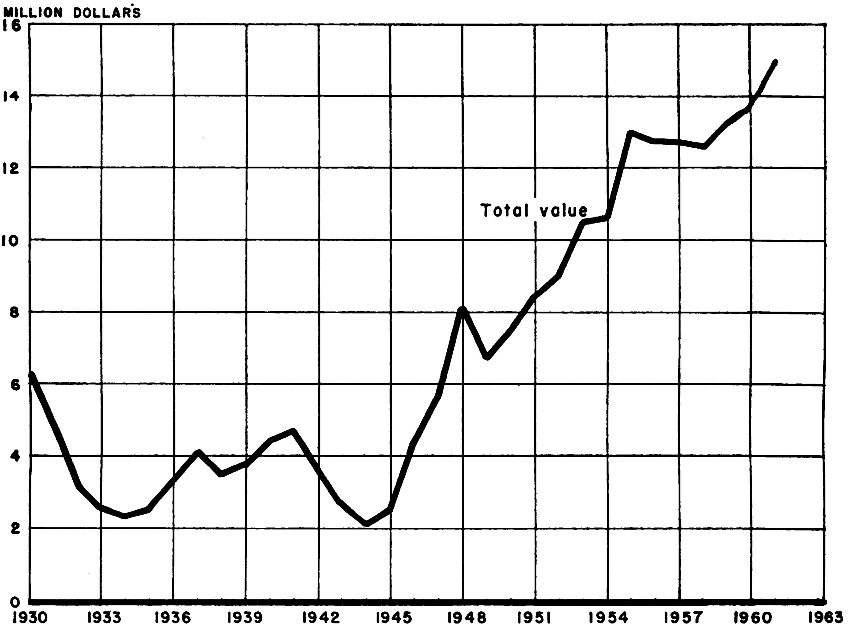

FIGURE 1.—Total value of mineral production in Maine, 1930–61.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Production and shipments of portland cement increased 11 and 17 percent, respectively. The average value per barrel increased slightly. Production consisted mostly of general-use and moderate-heat cement (types I-II). Some high-early-strength cement (type III) also was produced. The sole producer of cement in Maine was Dragon Cement Co., Inc., Division of American-Marietta Co., at Thomaston, Knox County. In October, American-Marietta Co. merged with The Martin Co. to form Martin Marietta Corp. Annual capacity of the wet-process plant remained at 2,050,000 barrels. Shipments of masonry cement and the average value per barrel also increased. Portland and masonry cement shipments were confined to the New England States, chiefly Maine and Massachusetts. None was exported in 1961. The portland cement was shipped mostly by truck, both in bulk and in paper bags, although substantial quantities were shipped by rail. The principal consumers of portland cement, in order of size, were ready-mixed concrete companies, building-supply dealers, and concrete-product manufacturers. Most of the remainder was consumed by highway and other contractors.

Clays.—Output of clays rose slightly in response to continued activity in building construction. Common or miscellaneous clay from nearby clay pits was mined for use in making building brick at eight plants—two in Androscoggin County, four in Cumberland County, and one each in Franklin and York Counties. A small quantity of fire clay (stoneware clay) was produced in Hancock County for art pottery and dinnerware.

Feldspar.—Severe competition, high production costs, and imports of foreign china reduced the output of feldspar to the lowest level since at least 1906. Production dropped nearly 40 percent, and the average value decreased from $6.09 to $6.00. Nearly three-quarters of the feldspar mined came from Oxford, and the balance was obtained from Androscoggin County. No production was reported from Sagadahoc County. Feldspar grinder and producer reports indicated output by five producers at seven mines in Oxford County and two mines in Androscoggin County.

Only one mill, at West Paris, Oxford County, ground feldspar. Both the Topsham grinding plants, one manufacturing poultry grit and the other ceramic feldspar, were idle. The West Paris mill sold ground feldspar, mostly for ceramic purposes. Sizable quantities, however, were marketed for soaps and abrasives, metal polish, and other purposes. Following the drop in production of crude feldspar, ground feldspar sales decreased drastically. Shipments were largely to North Central and Eastern States. A small quantity was exported.

Gem Stones.—The principal area for collecting gem-quality stones and mineral specimens was Oxford County. Included among the specimens were tourmaline, rose and rutilated quartz, kunzite, purpurite, lithium minerals (amblygonite, lepidolite, and spodumene), apatite, agate, opalite, mica, beryl, amethyst, and torbernite. Other counties in which mineral specimens had been found in recent years were Androscoggin (garnet), Cumberland (diopside, epidote, and smoky quartz), Hancock (chalcopyrite, molybdenum, and jasper), Kennebec (nephelite and zircon), Sagadahoc (beryl, feldspar, mica, and tourmaline), Washington (galena), and York (garnet and molybdenum).

Mica.—Foreshadowing the cessation of the Government purchase of sheet mica for the national stockpile at the end of June 1962, sales to GSA depots in 1961 were about one-fourth of 1960 sales and totaled less than 7,400 pounds in terms of full-trim mica. This decline was attributed to the lack of incentive for exploration and development of new prospects and mines. Nearly all the mica was mined in Oxford County and was sold to the GSA purchase depots at Franklin, N.H., Spruce Pine, N.C., and Custer, S. Dak., as hand-cobbed or full-trim material. A small quantity was obtained from Sagadahoc County. No sheet mica was reported sold to industry. Mica grinders purchased small quantities of scrap mica from undesignated locations. Twenty-two individuals or firms reported sales of sheet mica to GSA from eight mines.

Nitrogen Compounds.—Anhydrous ammonia for use in fertilizers was manufactured at Searsport, Waldo County.

Sand and Gravel.—Although road and building construction programs continued, output of sand and gravel decreased 9 percent in tonnage and 2 percent in value. Substantial increases in commercial structural sand and gravel and paving gravel and Government-and-contractor paving sand were more than offset by losses in commercial paving sand and fill and in Government-and-contractor paving gravel. Cumberland County retained its position as the largest sand and gravel producing county, even though 15 percent less tonnage was mined. Penobscot, Androscoggin, Aroostook, and Kennebec Counties were next in order of size and value of production. Indicative of more exacting specifications, washed, screened, or otherwise prepared material comprised 70 percent of the commercial sand and gravel, compared with 64 percent in 1960, and 56 percent of Government-and-contractor tonnage, compared with 30 percent in 1960.

Government-and-contractor production comprised nearly 75 percent of the total sand and gravel, compared with 80 percent in 1960, and 84 percent in 1959. The Maine Highway Commission, the largest producer in Maine, mined sand and gravel, mostly for highway and road construction and maintenance.

Stone.—Heavy demand for dressed architectural granite, higher prices, and more preparation for certain types of flagging were the chief factors in a 22-percent rise in value of stone. Quantity of crushed and broken stone produced was only slightly less than in 1960. Output of crushed and broken sandstone, limestone, and miscellaneous stone decreased, but this decline was almost offset by increases in crushed and broken granite. No output of basalt was reported. Sales of dimension slate were substantially less. Fourteen commercial stone quarries were active in eight counties; Seven for granite in five counties; three for limestone in one county; two for quartzite in two counties; and one for slate in one county. Four granite quarries produced only dimension stone; one only crushed and broken stone; and three both dimension and crushed and broken stone.

TABLE 2.—Sand and gravel sold or used by producers, by classes of operations and uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Structural	186,217	$127,989	303,071	$249,739
Paving	238,021	204,262	132,328	94,067
Engine	2,989	3,736	2,206	2,757
Fill	117,577	34,929	133,691	48,290
Other	33,232	11,341	71,319	39,308
Gravel, construction:				
Structural	231,711	287,796	338,329	390,008
Paving	793,014	366,559	1,037,748	546,396
Railroad ballast	27,993	8,267	46,173	40,845
Fill	228,104	80,226	119,962	55,828
Other	31,146	14,274	1,073	546
Gravel, miscellaneous	78,486	41,389	88,871	45,635
Total	1,968,490	1,180,768	2,274,771	1,513,419
Government-and-contractor operations:				
Sand:				
Structural	----------	----------	23,014	8,055
Paving	522,308	201,634	618,234	230,039
Other	3,038	1,113	3,105	642
Gravel:				
Paving	7,334,362	2,505,383	6,001,098	2,043,841
Fill	5,260	2,705	340	110
Total	7,864,968	2,710,835	6,645,791	2,282,687
Grand total	9,833,458	3,891,603	8,920,562	3,796,106

Crushed and broken limestone was used principally in the manufacture of cement, with sizable tonnages for agricultural purposes and papermaking, and a small quantity for riprap. Crushed and broken granite and quartzite were consumed in concrete and roadstone and as riprap. Uses of dimension granite included rough and dressed architectural and construction stone, rough and dressed monumental stone, rubble, curbing and flagstone, and paving blocks. Uses of dimension slate consisted of electrical slate and flagging. Dimension granite was quarried in Waldo, Hancock, York, and Knox Counties, and dimension slate entirely in Piscataquis County. The chief stone-producing counties, in order of quantity of stone marketed, were Knox, Cumberland, and Penobscot, and in order of value, Knox, Hancock, and Waldo.

METALS

Increased interest in possible development of the metallic mineral resources of Maine was evidenced by exploration and drilling underway by several firms. Included among these projects were exploration for copper and zinc by two firms in Hancock County and for copper by one company in northern Oxford County. Investigation of copper anomalies in Somerset County by the Federal Geological Survey also was reported.

Beryllium Concentrates.—Beryllium concentrates from Oxford and Sagadahoc Counties were sold through the GSA purchase depot at Franklin, N.H., by two producers, one from each county. The concentrates averaged 10.77 percent beryllium oxide. Production was higher than in 1960.

Nickel.—Nickel prospects in Knox County were investigated by one company which has been drilling in this area for about 5 years. A number of promising zones had been located. Copper and cobalt also were said to be present.

REVIEW BY COUNTIES

The Maine State Highway Commission produced paving sand and gravel in all counties; the output was obtained both by its own crews and workers under contract. Small quantities of building sand and gravel for fill also were mined. In addition, Acadia National Park in Hancock County, four towns or municipalities in Androscoggin County, two in Hancock County, and one in Penobscot County mined sand and gravel for local street maintenance. Acadia National Park in Hancock County contracted for production of miscellaneous stone for use as roadstone. The Maine State Highway Commission used its own crews in Hancock and Penobscot Counties to produce sandstone for road construction.

TABLE 3.—Value of mineral production in Maine, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Androscoggin	(1)	(1)	Sand and gravel, clays, feldspar.
Aroostook	(1)	$420,843	Sand and gravel.
Cumberland	$1,107,479	1,287,395	Sand and gravel, stone, clays.
Franklin	(1)	(1)	Sand and gravel, clays.
Hancock	(1)	(1)	Stone, sand and gravel, clays, gem stones.
Kennebec	827,431	305,645	Sand and gravel.
Knox	(1)	(1)	Cement, stone, sand and gravel.
Lincoln	73,570	(1)	Sand and gravel.
Oxford	(1)	(1)	Sand and gravel, mica, feldspar, gem stones, beryllium concentrates.
Penobscot	840,993	613,502	Sand and gravel, stone.
Piscataquis	(1)	(1)	Stone, sand and gravel.
Sagadahoc	59,239	92,296	Sand and gravel, beryllium concentrates, mica, gem stones.
Somerset	121,323	160,352	Sand and gravel.
Waldo	(1)	(1)	Stone, sand and gravel.
Washington	(1)	143,766	Sand and gravel.
York	(1)	(1)	Stone, sand and gravel, clays.
Undistributed [2]	[3]10,646,762	11,944,831	
Total	[3]13,677,000	14,969,000	

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes value of some sand and gravel (1960), mica, gem stones (1961), and beryllium concentrates (1960) that cannot be assigned to specific counties; and values indicated by footnote 1.

[3] Revised figure.

Androscoggin.—Eleven commercial sand and gravel producers were active; most were near Lewiston, Leeds, Durham, Webster, and Auburn. Sixty-three percent of the sand and gravel was prepared, mostly for building and paving material and as fill; a smaller quantity was prepared for railroad ballast.

Miscellaneous clay was produced from open pits by two companies near Auburn for use in making building brick.

Pechnik Bros. produced crude feldspar at the LaFlamm mine and sold the material to Bell Minerals Co. Bell Minerals Co. produced crude potash feldspar at the Phillips mine near Minot. The crude material was transferred to the company-owned grinding mill in Oxford County for further processing.

Aroostook.—Total output of sand and gravel exceeded 1 million short tons. Commercial sand and gravel was produced by four operators near Presque Isle, Houlton, and Hodgdon. Building gravel, gravel for ice control and railroad ballast, and paving sand and gravel were produced.

Rockland & Rockport Lime Co., Rockland, purchased the McKay Rock Products, Inc., plant in Presque Isle in the latter part of 1961. This operation included a 12-ton-per-hour agricultural lime crushing mill[4] and provided the purchasing firm with a new market for its ready-mixed concrete product and its agricultural lime business.

A geochemical anomaly located in Aroostook County contained molybdenum in concentrations 90 times greater than that formerly found in the region.[5]

Cumberland.—Although tonnage decreased 15 percent and value increased 11 percent, Cumberland County led in output and value of sand and gravel, with nearly 1,400,000 short tons valued at $681,000. Seventy-one percent of the commercial production was prepared, and the entire output was transported by truck. Sand and gravel, mostly for building and paving use, and fill sand were produced by seven producers, two less than in 1960. Leading producing areas were Portland, Cumberland Center, and Scarborough. Leading producers were Cumberland Sand & Gravel Co., Inc., and Maynard W. Robinson & Sons, both near Cumberland, and P. E. Hamlin, Portland.

Crushed granite was quarried near Portland by Cook & Co. for use as riprap, concrete aggregate, and roadstone. Quartzite was quarried and crushed by Blue Rock Quarry, Westbrook, chiefly for concrete aggregate and roadstone and for riprap.

Cumberland County was the largest clay-producing area in the State. Four producers mined clay—two from pits near North Yarmouth and one each from pits near Gorham and Cumberland Center. The miscellaneous clay was crushed, ground, and screened for use in making building brick.

Franklin.—Building and paving sand and building gravel were recovered from pits near Wilton and Weld.

Miscellaneous clay for manufacturing building brick was mined near West Farmington.

Hancock.—Output of granite more than doubled in tonnage, and increased 37 percent in value. Dimension granite was quarried by three producers near Hall Quarry and Stonington, principally for use as dressed construction stone, and rough dressed architectural stone, and dressed monumental stone.

Building and paving gravel and fill gravel were recovered from pits near Blue Hill, Ellsworth, Winter Harbor, and Gouldsboro.

Stoneware clay for making art pottery and dinnerware was recovered from a pit near East Blue Hill.

A small quantity of jasper, collected near Deer Isle, was used as gem material for making costume jewelry.

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[4] Pit and Quarry, v. 54, No. 10, April 1962, p. 130.

[5] U.S. Geological Survey. Geological Survey Research 1961. Professional Paper 424–A, 1961, p. A–95.

Exploration for copper, zinc, and silver continued at the Mammoth mine of Blackhawk Mining, Ltd., near Blue Hill. The initial expenditure was $30,000. Work involved drilling, exploration, and geophysical prospecting on a 650-acre area surrounding Second Pond; this area, known as the Blue Hills Group, included Second Pond, Douglas mine, and Mammoth mine. The company reported that magnetometer and electro-magnetic surveys and drilling programs had outlined four mineralized zones at Blue Hill. Penobscot Mining Corp., Harborside, was developing its Cape Rosier Group and Goose Falls Pond prospects for copper and zinc.

Kennebec.—Two commercial sand and gravel producers recovered building and paving sand and gravel from pits near Augusta and Stillwater.

Blue Rock Quarry, Westbrook, purchased a 25-acre tract between Augusta and Waterville which contained a large reserve of limestone. This firm produced crushed stone, concrete products, and bituminous aggregates, and was building a fully automated batching plant in Sidney, near Augusta, for its expanding ready-mix operations.[6]

Knox.—Dragon Cement Co., Inc., Division of Martin Marietta Corp. quarried and crushed captive cement rock for use in manufacturing cement at its two-kiln plant at Thomaston. General-use and moderate-heat portland cement, made by the wet process, comprised the bulk of the output, although some high-early-strength cement also was produced. Shipments of cement were mostly in bulk by truck to ready-mixed concrete companies and building-material dealers.

Knox County continued to lead in the production of stone, with increases in tonnage and value of 8 and 20 percent, respectively. Hocking Granite Industries, Inc., Clark Island, produced and sold dimension granite, mainly for use as dressed-construction, archictectural, and curbing stone. Some crushed granite for riprap also was produced. Tonnage and value of limestone increased 7 and 16 percent, respectively. Rockland-Rockport Lime Co., Rockland, produced crushed or broken limestone at a stationary plant, mostly for agricultural purposes and partly for papermaking and riprap. A history of blasting operations at this firm's quarry was published.[7] Changing from jackhammer drilling, bench blasting, and blockholing to deep-hole drilling and heavier blasting resulted in much better fragmentation, less downtime due to crusher jamming, and increased output of pulverized lime (calcining had been discontinued in 1954). Lime Products Corp. mined and crushed limestone for use in papermaking at a quarry and plant near Union.

Commercial building and paving sand, paving gravel, and fill gravel were recovered from a pit near Warren. Some of the material was sold to local government agencies.

Exploration for nickel, copper, and cobalt at the Harriman-Crawford Pond prospect in the East Union area cost roughly $1 million in 1961, and 25 apparently productive areas of nickel deposits had been located by a drilling program covering a 500-acre region.[8]

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[6] Pit and Quarry, v. 54, No. 3, September 1961, p. 25.

[7] Pit and Quarry. Modern Blasting Methods Pay Off in Historic Limestone Quarries. V. 54, No. 2, August 1961, pp. 108–110.

[8] Engineering and Mining Journal, v. 163, No. 3, March 1962, p. 130.

Lincoln.—Howard R. Wright, New Castle, sold screened building and paving gravel and bank-run fill gravel. Shipment was by truck.

Oxford.—Three operators of stationary plants, near Mexico, Norway, and Rumford, produced mostly building and paving gravel and fill gravel. Sand for ice control was sold to the Main State Highway Commission.

Total output of mica produced in Oxford County was sold chiefly through the GSA (Franklin, N.H., and Spruce Pine, N.C.) purchase depots. A small quantity was sold through the Custer (S. Dak.) depot. Production and value of mica declined considerably. Sales of hand-cobbed mica decreased 77 percent. Sales of full-trim mica decreased 67 percent. Twenty-one producers (32 in 1960) worked 7 mines (13 in 1960) at various locations. Mines yielding the most mica were the Wardwell, Albany; Wheeler, Gilead; Rich, Mason; and Pelletier, Norway.

Tonnage and value of feldspar declined to about one-half the production reported in 1960. Four producers mined potash-soda feldspar at five open-pit mines near Hebron, West Paris, and Buckfield. Bell Minerals Co., the leading producer, ground feldspar for ceramic uses, including electrical porcelain, sanitary tile, and pottery; for soaps and abrasives; and for metal polish. Major shipments were made to Pennsylvania, Wisconsin, and New York; smaller quantities went to other States.

Oxford County continued as the main source of gem material and mineral specimens. Rose quartz, tourmaline, lepidolite, cookeite, agate, and opalite specimens were collected near Newry, Black Mountain, Greenwood, and Richardson Lake by dealers for resale and jewelry manufacture and by individual collectors as a hobby.

Production and value of beryllium concentrate dropped considerably. The Wardwell mine near Albany was the only beryl mine operated, and sales were to the GSA (Franklin, N.H.) purchase depot.

Promising copper deposits apparently were located in the Cupsuptic Lake section, in the northern part of the county, by The Anaconda Copper Co. Exploration drilling by Ruberoid Asbestos Co. for asbestos deposits near Parmachenee Lake, also in the northern part of the county, entered its second year.

Penobscot.—Production of sand and gravel from 6 operations totaled 974,000 short tons, 37 percent less than in 1960. This tonnage consisted mostly of building and paving sand and gravel and fill sand and gravel for fill and railroad ballast; it was produced chiefly near Orono, Lincoln, and Lincoln Center. Eighty-three percent of the material was processed, and the output was transported by truck.

Bridge Construction Corp., Orono, produced crushed and broken sandstone for use as road material. The Maine State Highway Commission produced and crushed sandstone for use as concrete and roadstone.

The extent and economic possibilities of aeromagnetic anomalies in eastern Penobscot County were studied.[9]

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[9] Doyle, Robert G., Robert S. Young, and Lawrence A. Wing. A Detailed Economic Investigation of Aeromagnetic Anomalies in Eastern Penobscot County, Maine. Maine Geol. Survey, 1961, 69 pp.

Piscataquis.—Portland-Monson Slate Co. operated the Nos. 2 and 4 underground slate mines at Monson, obtaining the slate by block caving, a method unique in slate mining. The slate was processed at the local finishing mill, mainly for use as heavy-switch gear panels and flagging. Some of the finished flagging and electrical slate was exported to Canada.

A general drilling program by Scott Paper Co. for base metals was in its third year in the Greenville area in Piscataquis County.

Sagadahoc.—Building gravel and small quantities of sand for use as paving and fill material were sold from pits near Bath and Topsham.

Production and value of beryllium concentrates increased considerably. The beryl was recovered from the Georgetown mine, Georgetown, by Arthur O. Trusiani and sold to the GSA purchase depot.

Full-trim mica recovered from the Trott Cove mine near Woolwich was sold to the GSA (Franklin, N.H.) purchase depot.

A small quantity of autunite gem material was collected near Georgetown as a mineral-collector's item.

Somerset.—Building and paving and fill sand and gravel were recovered from pits near Smithfield and Waterville.

Two major copper geochemical anomalies were discovered on Sally Mountain in the Attean quadrangle in the western part of the county.[10]

Waldo.—Waldo County ranked second as a stone-producing area. Tonnage increased 9 percent, and the value more than doubled, due to increased demand for dressed dimension architectural stone. Grenci & Ellis, Inc., quarried dimension granite for use as dressed architectural stone. This firm also supplied stone for the exterior of the New England Life Insurance Building at Boston, Mass.

Washington.—Gravel, sold principally for use as paving and fill gravel, and railroad ballast, was recovered from pits near Machias and Ellsworth.

A geological study of the area near Cutler in the southeastern part of the county was published.[11]

York.—John Swenson Granite Co., Inc., quarried dimension granite as dressed architectural stone at the Swenson Pink quarry, Highpine, and the Swenson Green quarry, York. Some crushed stone also was produced, chiefly for use as riprap.

Seventy-six percent of the 456,000 short tons of sand and gravel produced was processed for use as building and paving material and fill. Pits were operated near Biddeford, Sanford, and York.

Morin & Sons Brick Manufacturing Co., Eliot, produced miscellaneous clay for manufacturing building brick. The company installed a new dryer for drying brick.

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[10] U.S. Geological Survey. Geological Survey Research 1961. Professional Paper 424–A, 1961, p. A–95.

[11] Gates, Olcott. The Geology of the Cutler and Moose River Quadrangles, Washington County, Maine. Maine Geol. Survey, 1961, 67 pp.

The Mineral Industry of Maryland

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Maryland Department of Geology, Mines, and Water Resources.

By N. A. Eilertsen[1]

◆

THE VALUE of mineral production in Maryland increased 12 percent to establish a new high of $62.3 million in 1961. Sand and gravel and crushed stone were mainly responsible for the rise. Stone surpassed cement in value of production and became the leading commodity.

Baltimore County led in value of mineral output with Prince Georges County, the largest producer of sand and gravel, assuming second place.

TABLE 1.—Mieral production in Maryland[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.......thousand short tons..	[2] 612	[2] $853	581	$997
Coal (bituminous).......do.....	748	2,799	757	2,868
Gem stones........	(3)	2	(3)	3
Lime.......thousand short tons..	(4)	(4)	96	1,302
Natural gas.......million cubic feet..	4,065	1,081	3,578	973
Sand and gravel.......thousand short tons..	10,076	13,221	12,404	16,894
Stone.......do.....	7,944	16,962	10,671	21,203
Value of items that cannot be disclosed: Cement (masonry and portland), greensand marl, peat (1961), potassium salts, talc and soapstone, and values indicated by footnote 4........	....	22,779	....	20,153
Total Maryland[5]........	....	55,527	....	62,264

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producer).

[2] Excludes ball clay; included with "Value of items that cannot be disclosed."

[3] Weight not recorded.

[4] Figure withheld to avoid disclosing individual company confidential data.

[5] Total adjusted to eliminate duplicating value of clays and stone used in manufacturing cement and lime.

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[1] Supervising mine examination and exploration engineer, Bureau of Mines, College Park, Md.

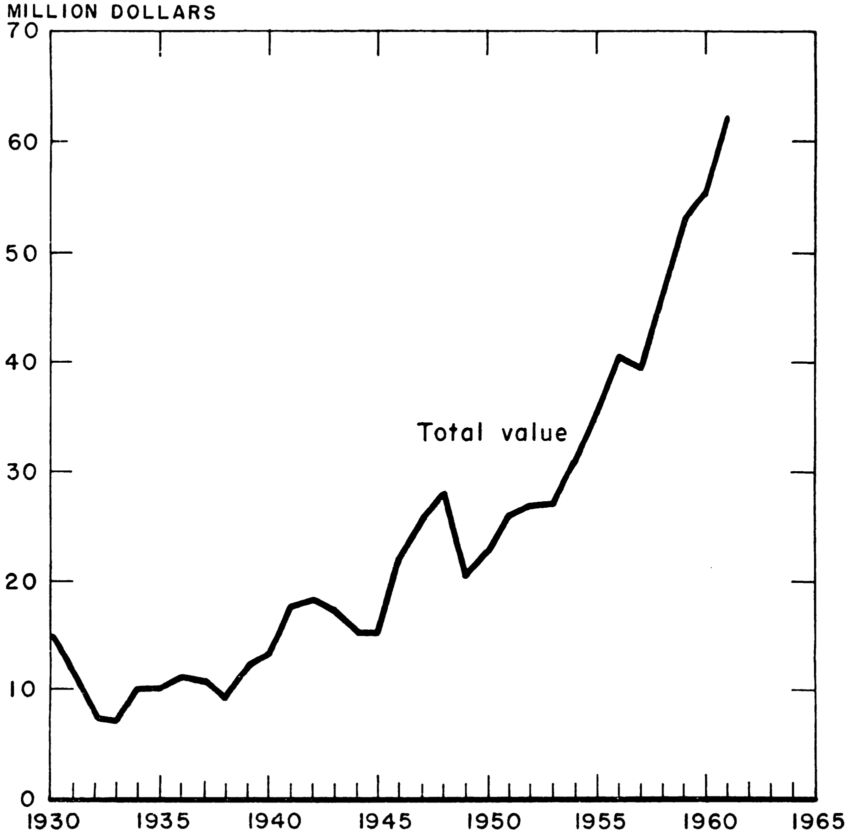

FIGURE 1.—Value of mineral production in Maryland, 1930–61.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipment of portland and masonry cement decreased 7 percent in comparison with 1960. Production of portland cement was 71 percent of capacity, a decrease of 6 percent from 1960. Both wet and dry process plants were operated. Over 70 percent of the cement was produced by the dry process. Most of the power used for plant operation was purchased electrical energy; 8 percent less power was used in 1961.

Cement from plants in Carroll, Frederick, and Washington Counties was shipped to several States, but the bulk of production was consigned to Maryland, District of Columbia, Virginia, and Pennsylvania. More cement was used for ready-mixed concrete than for any other use, with concrete products and highway construction next in order of usage.

Clays.—Production of clays was 7 percent less than in 1960, owing to weakening of demand for all types. Decline in cement production and lower requirements by the construction industry for clay products were important factors. Production of miscellaneous clay dropped 6 percent. Demand for ball clay and fire clay was 14 percent and 22 percent, respectively, less than in 1960. Baltimore and Prince Georges Counties led in the production of miscellaneous clay, and Allegany County ranked first in production of fire clay.

Gem Stones.—Small quantities of semiprecious gem stones and mineral specimens were collected chiefly by hobbyists in Calvert, Cecil, Frederick, and Howard Counties. The material included jarosite, gypsum crystals, williamsite, breccia-marble, and pyrite crystals.

Gypsum.—Wallboard and base coat plasters were manufactured at a plant near Baltimore from imported gypsum.

Lime.—Tonnage of lime produced was more than double that of 1960. Productive capacity was increased with the addition of a fourth lime plant. Lime was produced in Allegany and Frederick Counties.

Marl, Greensand.—Greensand marl was produced from a deposit in Calvert County and marketed as a natural soil conditioner.

Perlite, Expanded.—Crude perlite from producers in Western States, chiefly New Mexico, was processed at plants in Baltimore and near Washington, D.C. The expanded product was used principally for building plaster, lightweight concrete aggregate, and as a filter aid.

Pigments.—A plant in Prince Georges County manufactured a wide variety of iron oxide pigments from raw material obtained outside the State. Titanium dioxide pigments were manufactured at two large plants near Baltimore.

Potassium Salts.—Potassium sulfate was produced in Washington County as a byproduct from the manufacture of cement.

Sand and Gravel.—Production of sand and gravel increased 23 percent over the tonnage sold or used in 1960. Most of the increased output of sand and gravel was used for paving. The tonnage of sand used for making glass rose 19 percent and that used for grinding and polishing was up 18 percent.

The average value per ton of sand and gravel sold or used by producers in Maryland was $1.36 compared with $1.31 in 1960. The tonnage ratio of sand to gravel production was 1:1.07. Commercial sand and gravel was produced in 15 counties. Prince Georges County led, followed in decreasing order by Anne Arundel, Baltimore, and Cecil Counties. Government-and-contractor production was reported from Prince Georges, Talbot, and Wicomico Counties.

Stone.—Stone output was up 34 percent over that of 1960. While the production of limestone increased 10 percent, output of crushed basalt used for concrete aggregate more than doubled in tonnage. More limestone was marketed, principally for concrete and roadstone, but also for screenings, railroad ballast, agstone, whiting, poultry grit, and filler used in various manufactured products. Baltimore was the leading county in limestone production, and Howard County led in output of crushed basalt.

Crushed oystershell, principally for poultry grit and lime, continued to be produced in two Maryland counties. Shipments from plants were by rail and truck. Production decreased 8 percent from 1960.

TABLE 2.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1960		1961	
	Quantity	Value	Quantity	Value
Sand:				
Structural	2,578	$3,233	3,049	$3,898
Paving	1,867	2,541	2,438	3,548
Fill	44	16	24	17
Other	(1)	(1)	330	509
Gravel:				
Structural	2,136	3,484	2,080	3,820
Paving	1,979	2,798	2,276	3,200
Fill	31	14	859	715
Other	(1)	(1)	589	329
Gravel, miscellaneous	418	247	455	341
Undistributed [2]	1,023	888	304	517
Total [3]	10,076	13,221	12,404	16,894

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes glass, grinding and polishing, fire or furnace (1960), and engine sand; railroad ballast gravel (1960).

[3] Includes Government-and-contractor paving sand and gravel.

No dimension granite was produced in 1961, but output of crushed granite increased slightly.

Talc and Soapstone.—Production of talc and soapstone decreased 6 percent in tonnage. Most of the crude output was ground and marketed for use in manufacture of rubber, roofing materials, foundry castings, and refractories. Some block talc was sawed and machined to various refractory products. Producing counties were Carroll and Harford.

Vermiculite, Exfoliated.—A plant in Beaver Heights, Prince Georges County, produced exfoliated vermiculite from crude material obtained from sources outside the State.

MINERAL FUELS

Coal (Bituminous).—A 1-percent increase in coal production was due chiefly to greater output from underground mines in Garrett County. Production from 37 underground mines (11 less than in 1960) increased 10 percent. The tonnage of coal produced by strip mining decreased 4 percent, chiefly because of less output from surface mines in Garrett County. A total of 33 strip mines operated in the State, 4 less than in 1960. Coal from strip mines comprised 62 percent of the output and was valued at $3.21 per ton compared with $4.72 a ton for coal from underground mines. The average value per ton was $3.79. Garrett County produced 76 percent of the production.

Maryland coal was produced mostly from numerous small underground mines and contour strip operations on sloping hillsides. In underground mining, 85 percent of the coal was cut by machine. The remainder was shot from solid and cut by hand. Of the coal produced underground, 90 percent was face-drilled with a total of 42 handheld and postmounted power drills. Three rock drills were used in roof bolting. About one-third (37 percent) of the coal was hand-loaded onto face conveyors. Production from strip mining was obtained with the usual equipment—bulldozers, dragline excavators, and power shovels. Of the total State output, 30 percent was crushed and sized.

Coke and Coal Chemicals.—Bethlehem Steel Corp. produced coke and coal-chemical materials at its Sparrows Point furnace plant. The 757 Koppers-Becker ovens with an annual coke capacity of 3,510,000 short tons produced byproduct coke breeze, coke oven gas, ammonium sulphate, crude coal tar, crude light oil, benzene, toluene, xylene, intermediate light oil, and naphthalene (under 74° C). Tonnage of coke produced decreased 4 percent from the 1960 total. Bethlehem Steel Corp. planned to construct one of the country's largest tar distillation units at Sparrows Point.[3] The unit would be used to recover chemicals from coke oven tar for processing in the Allied Chemical Corp. plant at Philadelphia, Pa. It was expected that the plant would have capacity to process annually more than 50 million gallons of tar into a chemical fraction containing more than 42 million pounds of crude naphthalene.

Natural Gas and Petroleum.—Output of natural gas from the Mountain Lake Park and Accident fields in Garrett County continued at about the same rate as in 1960.

There was no production of petroleum in Maryland, but American Bitumuls & Asphalt Co., The American Oil Co., and Humble Oil & Refining Co. maintained skimming and asphalt plants in the Baltimore area, using crude oil shipped into the State. Daily crude oil capacities were, respectively, 7,500; 9,000; and 16,500 barrels a day.

Peat.—Humus peat was produced in Kent County and marketed in bulk form. Production of peat had not been reported for the past several years.

METALS

Copper.—Kennecott Copper Corp. operated its newly constructed electrolytic copper refinery at Hawkins Point in Anne Arundel County. The plant produced refined high-purity copper orginating at the company copper mines in Utah, Nevada, New Mexico, Arizona, and Chile. Operations were continuous for the entire year.

REVIEW BY COUNTIES

Allegany.—Production of coal decreased 9 percent. Because of a drop in number of operating underground mines from 24 in 1960 to 14, underground coal production decreased 23 percent. Leading operators were Gary Coal Co. with two mines (one each in the Bakerstown and Freeport coal seams) and W. & W. Coal Co., producing in the Bakerstown seam. Operating strip mines increased by 1 to 17, and the tonnage increased 1 percent. Output from the leading strip mines was obtained from the Franklin and Pittsburgh coal seams.

West Virginia Pulp and Paper Co. from its new plant near Luke in Allegany County burned quicklime in two natural gas-fired rotary kilns. Output was all used in paper manufacture. Total production and value of sand and gravel decreased slightly during the year. Cumberland Cement & Supply Co. processed sand and gravel at its River No. 3 plant near Cumberland for building and paving material.

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[3] Pittsburgh Press, Feb. 23, 1961, p. 14.

Building and industrial sands were marketed from the Quartzite Plant No. 1.

TABLE 3.—Value of mineral production in Maryland, by counties[1] [2]

County	1960	1961	Minerals produced in 1961 in order of value
Allegany	$1,912,778	$2,756,530	Coal, lime, sand and gravel, stone, clays.
Anne Arundel	(3)	1,987,367	Stone, sand and gravel, clays.
Baltimore	[4] 11,222,062	12,635,102	Do.
Calvert	(3)	(3)	Greensand marl, gem stones.
Caroline	(3)	(3)	Sand and gravel.
Carroll	(3)	(3)	Cement, stone, clays, soapstone.
Cecil	1,537,378	1,802,114	Stone, sand and gravel, clays, gem stones.
Charles	(3)	(3)	Sand and gravel.
Dorchester	(3)	(3)	Sand and gravel, oystershell.
Frederick	7,905,813	7,397,031	Cement, stone, lime, sand and gravel.
Garrett	[4] 3,234,982	3,410,787	Coal, natural gas, stone, sand and gravel.
Harford	1,036,017	1,058,198	Sand and gravel, stone, talc.
Howard	(3)	(3)	Stone, gem stones.
Kent	17,000	75,200	Peat, sand and gravel, clays.
Montgomery	(3)	(3)	Stone.
Prince Georges	6,784,477	10,494,513	Sand and gravel, clays.
Queen Annes	67,000	40,000	Sand and gravel.
St. Marys	(3)	(3)	Do.
Talbot	(3)	(3)	Do.
Washington	(3)	(3)	Cement, stone, clays, potassium salts.
Wicomico	(3)	102,711	Sand and gravel, clays.
Worcester	(3)	(3)	Sand and gravel.
Undistributed [5]	[4] 21,809,118	20,503,587	
Total	55,527.000	62,264,000	

[1] Somerset County is not listed because no production was reported.
[2] Excludes value of clays and stone used in manufacturing cement and lime.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[4] Revised figure.
[5] Includes some gem stones and sand and gravel (1961) not assigned to specific counties and values indicated by footnote 3.

Fry Coal & Stone Co., Division of Martin Marietta Corp., produced crushed limestone from the Martin Mountain quarry near Flintstone, the Sensabaugh quarry near Cumberland, and the Cumberland quarry near Corrigansville for concrete aggregate and roadstone. Kaiser Refractories and Chemicals Division, Kaiser Aluminum and Chemical Corp., produced fire clay from one open pit and one underground mine near Frostburg. The material was used for manufacturing firebrick and block.

Anne Arundel.—The county ranked second in production of sand and gravel. Tonnage and value of sand and gravel decreased 6 percent and 8 percent, respectively. Sand and gravel was produced at seven operations near Linthicum, Hanover, Mitchellsville, and Davidsonville. Output was chiefly prepared building and paving sand and gravel, and bank-run material for fill. Severn Clay Co., Glen Burnie, produced fire clay for manufacture of sanitary ware and floor and wall tile.

Baltimore and Baltimore City.—The county continued to rank first in value of production among the 22 mineral producing counties in the State. Value of mineral output increased 13 percent. Stone led in value of minerals produced, followed by sand and gravel.

Crushed limestone for concrete aggregate and roadstone was produced by The Arundel Corp. at the Greenspring quarry near Baltimore. Harry T. Campbell Sons Corp., subsidiary of The Flintkote

Co., produced crushed limestone at the Texas and Marriottsville quarries. The material was marketed for many uses including concrete aggregate and roadstone. Crushed oystershell for poultry grit and byproduct lime were produced at the Oyster Shell Corp. mill near Baltimore. Basalt was quarried and crushed mostly for concrete aggregate, roadstone, and railroad ballast at plants near White Hall and Hyde. Dimension quartzite, both construction (rough) and architectural (dressed), and flagging was quarried by The C. E. Weaver Stone Co. at Butler.

Baltimore County ranked third in production of sand and gravel. Output, mainly building and paving sand and gravel, increased 2 percent over that of 1960, and came from seven plants operated near Baltimore, White Marsh, Perry Hall, and Landsdowne.

The tonnage of clay produced decreased 33 percent from the preceding year. Miscellaneous clay was produced by three companies at four pits. Output was used for the manufacture of building brick. Excelsior Brick Co., Baltimore, was sold and its name changed to Excelsior Clay Products Co. on June 1. The company planned to make 10 million face and common brick annually, as well as continuing its line of sewer brick. The company operated four round downdraft kilns and four rectangular updraft kilns.[4] Ball clay mined at a pit near Baltimore was marketed for use in making stoneware, pottery, firebrick and block, and vitrified sewer pipe.

National Gypsum Co. calcined imported gypsum at its plant in Baltimore. Completion of the new $5 million United States Gypsum Co. plant in Baltimore was scheduled for September 1962. The plant will cover 250,000 square feet on a 350-acre site. Baltimore Contractors, Inc., was awarded the general contract. This will be the first United States Gypsum Co. plant in the Baltimore area and the firm's seventh on the Eastern Seaboard.[5]

A plant in Baltimore expanded crude perlite (obtained from New Mexico) for use in building plaster and concrete aggregate. The expanded material was marketed as a filter aid.

Calvert.—Greensand marl was produced by Kaylorite Corp. (Dunkirk) and marketed for use as a soil conditioner.

Caroline.—Sand and gravel was produced by Cook & Son near Greensboro. Most of the processed material was used for building and paving construction.

Carroll.—The county ranked first in cement production and fourth in value of mineral production. Cement was the leading commodity produced. Lehigh Portland Cement Co., Union Bridge, mined and crushed limestone, sandstone, and shale for cement manufacture. General-use and moderate-heat as well as high-early-strength portland cements and masonry cement were produced. Consumption was largely intrastate, but significant quantities were marketed in neighboring States and in the District of Columbia. Most of the shipments were in bulk to ready-mixed concrete companies.

Limestone was quarried and crushed for concrete aggregate and road base material by Teeter Stone, Inc., a subsidiary of Harry T.

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[4] Brick and Clay Record, v. 139, No. 4, October 1961, p. 30.
[5] Pit and Quarry, v. 54, No. 1, January 1962, p. 23.

Campbell Sons Corp. Liberty Stone Co. mined and crushed soapstone at its plant near Marriottsville. Most of the material was transferred to the company's Sykesville plant for further processing. Processed soapstone was marketed for use in foundry facing and as a filler in asphalt, roofing, and rubber.

Cecil.—Basalt was mined at the Elk Mills quarry by D. M. Stoltzfus & Son, Inc., and crushed for concrete aggregate and roadstone. Granite was quarried for riprap and for crushing to concrete aggregate and roadstone near North East by Maryland Materials, Inc. In the same vicinity, Harbison-Walker Refractories Co. manufactured silica brick from quartzite quarried and crushed at its Leslie operation. Sand and gravel tonnage increased. Output from pits near Elkton, Port Deposit, North East, Perryville, and Rising Sun was used mostly for paving and building. Fire clay including plastic and some white clay was produced at two pits near North East. A small quantity of williamsite gem specimen material was collected in the county.

Charles.—A. D. Gamble & Son marketed paving sand and structural building gravel from a stationary plant near La Plata. The material was all shipped by truck.

Dorchester.—Processed sand and gravel for building construction and bank-run sand for fill were produced at a stationary plant near Federalsburg by J. Edwin Rosser, Inc. J. M. Clayton, Cambridge, produced crushed oystershell for poultry grit and lime.

Frederick.—Portland and masonry cements were manufactured at Lime Kiln by Alpha Portland Cement Co. Output was marketed mostly intrastate for many uses. The largest consumers of cement were the ready-mixed concrete companies. Limestone and cement rock were quarried and crushed near Frederick, Lime Kiln, Le Gore, Woodsboro, and New London. Output was chiefly used for concrete aggregate and roadstone and for cement and lime manufacture. Quicklime and hydrated lime were produced at three operations, one each near Le Gore, Middletown, and Woodsboro. Nearly all the output was marketed in the State and was used mainly in agricultural applications. Sand for building and paving was produced by Alpha Portland Cement Co. at Lime Kiln.

Garrett.—A drop of 5 percent in bituminous coal output from strip mines was more than offset by an increase of nearly 27 percent in production from underground mines, and as a result overall output increased 5 percent over 1960. Strip mine production decreased because five less mines were in operation. The two largest strip-mine producers in the county were Buffalo Coal Co., working in the Kittanning seam, and Moran Coal Co., producing from three mines in the Franklin seam. Underground mines decreased by 1 to 23, but added production came from 3 producers working in the Freeport seam.

Blue limestone was mined and crushed for concrete aggregate and roadstone at the Fry and Browning quarries, 9 miles north of Oakland, by Vetter Bros., Inc. The Fry quarry had a 44-foot-high face that required stripping 50 feet of overburden. Limestone was recovered by underground mining at the Browning quarry. Sand for controlling ice on roads and for building construction was obtained from two pits near Oakland.

Harford.—Value of sand and gravel dropped 3 percent. Nine operations near Abingdon, Aberdeen, Edgewood, Joppa, and Webster Village, produced and processed building and paving sand and gravel. Crushed basalt (trap rock) was produced at the Gatch and Grays Run quarries near Churchville and Aberdeen, respectively, for road material. Maryland Green Marble Co. produced sawed, cut and dressed marble for building interiors and crushed stone for terrazzo. Harford Talc & Quartz Co., Inc., mined and processed talc near Dublin. The company produced insulators machined from block talc and ground material used as a filler in foundry facings.

Howard.—Crushed basalt for concrete aggregate and roadstone was produced by Arundel Corp. at a quarry near Savage. Pyrite crystal specimens were obtained by mineral collectors in the vicinity of Marriottsville.

Kent.—Maryland Peat Humus Co., Betterton, produced and marketed humus peat for agricultural purposes in bulk form. Miscellaneous clay for building brick was mined from an open pit near Chestertown by Chestertown Brick Co.

Montgomery.—Mica schist was quarried for rough dimension building stone, flagging, and rubble by Stoneyhurst quarries near Bethesda. The Rockville Crushed Stone Co., Rockville, mined and crushed basalt (trap rock) for concrete aggregate and roadstone.

Prince Georges.—A 57-percent increase in both tonnage and value of commercial sand and gravel output raised Prince Georges County from third to second place in overall county valuation of mineral production. Eighty percent of the commercial output was processed by washing or screening and was used in building and paving. Production was reported from 17 operations, mostly near Laurel, Upper Marlboro, and the District of Columbia.

Washington Brick Co. (Muirkirk) and West Brothers Brick Co. near Washington, D.C., produced miscellaneous clay chiefly for manufacturing building brick. William L. Allen produced fire clay from a pit near Laurel for refractories and for use in foundries and steel work. Iron oxide pigments in a variety of colors were manufactured by Mineral Pigments Corp. at Muirkirk. A plant near Washington, D.C., produced expanded perlite for use chiefly in building plaster and concrete aggregate. Source of furnace feed was from mines in New Mexico, Idaho, and Arizona.

Queen Annes.—Bank-run and processed sand and gravel was produced at a stationary plant near Queenstown. The material was used for building construction, paving, ready-mixed concrete, and septic fields.

St. Marys.—Dean and Beavers produced processed sand and gravel at a stationary plant near Hollywood. Leonardtown Sand & Gravel Co. produced sand and gravel near Leonardtown. Material from both companies was marketed for building and paving.

Talbot.—A quantity of Government-and-contractor gravel was produced for State road work.

Washington.—Mineral production decreased over 6 percent in value compared with the preceding year and the county ranked third in value of minerals produced. Marquette Cement Mfg. Co., formerly North America Cement Corp., quarried and crushed limestone mostly for the manufacture of general air-entrained, general non-air-entrained, and high-early-strength cements at its Security plant near Hagerstown. The company also produced potassium sulfate as a byproduct of cement clinker. Most of the production was marketed in neighboring States and in the District of Columbia. Fry Coal & Stone Co., Division of Martin Marietta Corp., produced limestone used mainly for concrete aggregate and roadstone at quarries near Pinesburg and Hagerstown. Limestone for controlling coal mine dust and stone sand also was produced at the Pinesburg quarry. In addition, the company produced crushed limestone near Boonsboro and Hancock with a portable crushing plant. Miscellaneous clay used for manufacturing building brick, hydraulic cements, and fertilizers was produced near Williamsport by Victor Cushwa & Sons, Inc.

Wicomico.—Building and paving sand and gravel was produced at plants near Hebron, Salisbury, and Tyaskin. Salisbury Brick Co., Inc., obtained surface clay for manufacturing brick from a pit near Salisbury.

Worcester.—Crews of the Worcester County Highway Department produced bank-run sand and gravel for highway construction, maintenance, and repair.

The Mineral Industry of Massachusetts

By James R. Kerr[1] and Charles C. Yeloushan[1]

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THE VALUE of Massachusetts mineral production continued its upward trend, increasing 10 percent over 1960 to $30.2 million. Instrumental in the increased valuation was the $1.9 million increase in value of sand and gravel production. Evidence of accelerated roadbuilding was found in the large tonnages of fill material produced by both commercial and Government-and-contractor sand and gravel operators. Also contributing to the increased State mineral wealth was the greatly increased market for dressed architectural dimension granite. Production of clays and peat increased, but output of lime decreased slightly.

With large production of sand and gravel and crushed and dimension stone, Middlesex County contributed $9.5 million to State mineral value and was the leading mineral-producing area. Other important areas were Berkshire and Norfolk Counties.

TABLE 1.—Mineral production in Massachusetts[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... short tons..	83,221	$71	104,084	$85
Gem stones	(2)	1	(2)	2
Lime .... short tons..	153,710	2,370	144,831	2,307
Sand and gravel .... do....	14,789,470	13,013	18,060,656	14,958
Stone .... do....	5,247,420	12,782	5,210,140	13,399
Value of items that cannot be disclosed: Mineral fuels and nonmetals	....	8	....	38
Total Massachusetts[3]	....	27,588	....	30,234

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Total adjusted to eliminate duplicating value of stone.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Argon.—Argon was produced by Air Reduction Co., Inc., in connection with nitrogen compounds operations at South Acton, Middlesex County.

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[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

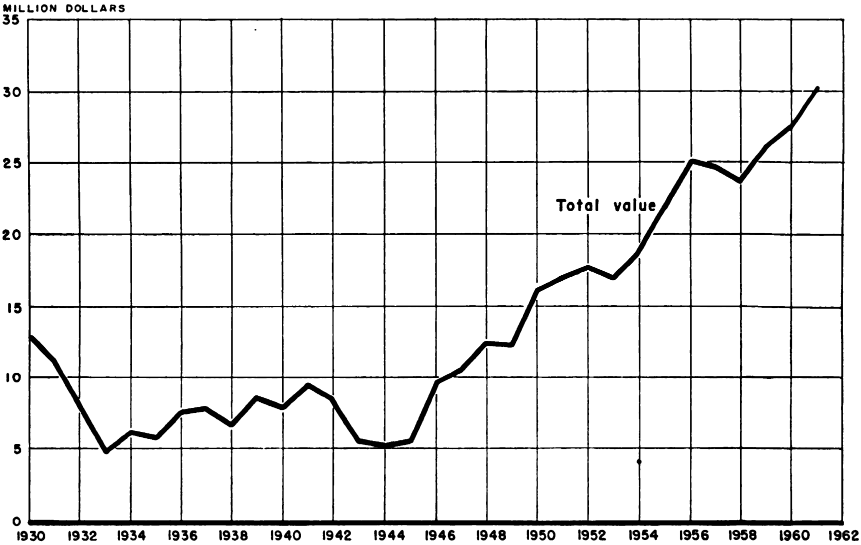

FIGURE 1.—Total value of mineral production in Massachusetts, 1930–61

Clays.—Even though one less producer was active, production of miscellaneous clay increased 25 percent as the Plymouth County operation of The Stiles & Hart Brick Co. operated the full year in 1961, compared with only 3 months in 1960. The State output was used entirely for the manufacture of building brick. Plans were announced to construct a lightweight aggregate plant at Plainville, Bristol County, by Masslite, Inc. Shale mined at Plainville would be raw material for the sintering operation.

Gem Stones.—Specimens of emery, various lead minerals, and other gem materials were collected, chiefly by hobbyists, from scattered locations throughout the State.

Gypsum.—A variety of calcined gypsum products was produced from crude imported Nova Scotia gypsum at a plant in Charlestown, Suffolk County.

Lime.—Quicklime and hydrated lime were produced for sale by three producers in Berkshire County. Output decreased 6 percent from the high of 1960 but was the second highest on record. Production was 65 percent of rated capacity. The largest consumer was the chemical industry, which purchased nearly 70 percent of lime output. Significant tonnage also was used by the construction industry. Leading chemical and industrial users were the paper, whiting, and tannery industries. Shipments were chiefly to the New England-New York area. New England Lime Co., Adams, Mass., was sold to Charles Pfizer & Co., New York, during the year.

Nitrogen Compounds.—Nitrogen was produced by Air Reduction Co., Inc., South Acton, Middlesex County. Plans were announced to triple capacity of this air separation plant with a $5.5 million expansion.[2]

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[2] Chemical Engineering. V. 68, No. 1, Jan. 9, 1961, p. 186.

TABLE 2.—Lime sold by producers

Year	Short tons	Value	Year	Short tons	Value
1952–56 (average)	132,911	$1,983,126	1959	143,567	$2,289,250
1957	137,284	2,232,731	1960	153,710	2,370,059
1958	139,062	2,120,677	1961	144,831	2,306,710

Oxygen.—Oxygen was produced by Air Reduction Co., Inc., in connection with nitrogen compounds operations at South Acton, Middlesex County.

Perlite.—Crude perlite purchased from producers at Antonito, Colo., was expanded at a plant in Roslindale, Suffolk County. Output, which was used as a lightweight aggregate in concrete and building plaster and as a soil conditioner, increased 19 percent over 1960.

Sand and Gravel.—Production of sand and gravel increased 22 percent to a new high of 18 million tons. Value of production, however, increased only 15 percent as the average price fell 5 cents to $0.83 per ton, because of greatly increased production of low-priced fill material. Commercial production of fill more than doubled, and output of over 2.5 million tons of Government-and-contractor sand, compared with none in 1960, was reported for fill. The large quantities of fill consumed indicate greatly increased activity in the initial stages of new road building programs. Of the commercial output, 78 percent was for building and paving use. Small tonnages of higher quality molding and foundry sands also were produced. Eighty percent of commercial output was processed material.

There were 176 active commercial pits, compared with 132 in 1960. In Middlesex County surrounding the Boston metropolitan area, 3.2 million tons was produced. Worcester, Norfolk, and Bristol Counties produced over 1 million tons each.

Government-and-contractor pits were active in every county except Suffolk. Output increased 40 percent, further reflecting increased road building activity. One hundred twenty-four pits were reported active, compared with 88 in 1960. Hampshire County led in Government-and-contractor output with 1.95 million tons, followed by Middlesex with 1.15 million tons. Other leading producing areas were Franklin and Bristol Counties.

Stone.—Production of stone decreased slightly in quantity, but increased 5 percent in value, chiefly because the valuation of dimension granite increased from $30.29 to $35.63 per ton. This increase in value was due to a sixfold increase in output of dressed architectural granite, the highest priced dimension use. Basalt, however, was the leading stone produced in terms of both tonnage and value, with large quantities consumed in concrete aggregate and road-base material. Production of crushed granite and miscellaneous stone decreased. Limestone, produced solely in Berkshire County, decreased in output but increased in value because of general price increases for the crushed product.

Stone production was reported from 12 counties. In terms of value, Middlesex County was the leading stone producing area, followed by Berkshire, Hampden, Essex, and Norfolk, all with production valued at more than $1 million.

TABLE 3.—Sand and gravel sold or used by producers, by classes of operations and uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Structural	2,907,009	$2,834,164	2,902,295	$2,850,051
Paving	1,440,099	1,356,408	1,820,941	1,805,699
Fill	286,475	128,111	706,570	225,099
Blast	2,500	12,500	(1)	(1)
Other	415,758	273,386	298,782	215,754
Gravel:				
Structural	2,705,770	3,738,376	2,973,410	3,941,914
Paving	2,030,664	1,969,937	2,133,955	2,209,048
Railroad ballast	5,800	3,200	(1)	(1)
Fill	510,291	279,665	918,817	503,792
Other	300,130	234,873	452,111	230,438
Undistributed [2]	295,549	497,447	407,288	620,744
Total	10,900,045	11,328,067	12,614,169	12,602,539
Government-and-contractor operations:				
Sand:				
Structural	----------	----------	515	515
Paving	162,382	91,068	152,687	93,748
Fill	----------	----------	2,563,187	952,381
Other	----------	----------	17,800	12,541
Gravel:				
Paving	3,497,881	1,550,148	2,302,795	1,152,982
Fill	229,162	44,070	409,503	143,326
Total	3,889,425	1,685,286	5,446,487	2,355,493
Grand total	14,789,470	13,013,353	18,060,656	14,958,032

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.
[2] Includes blast sand, molding sand, ground sand, railroad ballast gravel and miscellaneous gravel.

Roofing Granules.—Natural and artificially colored roofing granules were produced from miscellaneous stone at a plant in Norwood in Norfolk County. Output, which was used as a base for colored roofing granules or uncolored in asphalt roofing, was virtually the same as in 1960.

TABLE 4.—Stone sold or used by producers, by uses

Use	1960		1961	
	Short tons	Value	Short tons	Value
Riprap	77,672	55,851	96,073	141,732
Concrete aggregate and roadstone	3,788,199	6,144,033	3,859,202	6,144,156
Railroad ballast	342,197	462,162	252,266	386,922
Agricultural (limestone)	144,254	427,998	163,703	512,808
Undistributed [1]	895,098	5,691,986	838,896	6,213,157
Total	5,247,420	12,782,030	5,210,140	13,398,775

[1] Includes dimension stone, furance flux and other uses.

Vermiculite.—South African and domestic vermiculite were exfoliated at plants in Norfolk and Middlesex Counties and marketed chiefly as lightweight aggregate in plaster and concrete and for insulation.

MINERAL FUELS

Peat.—Production of peat increased over 2.5 times with the addition of a new producer in Worcester County—Sterling Peat Co. at Sterling Junction, which produced packaged and bulk reed-sedge peat.

METALS

Kennecott Copper Corp. announced plans to build a research laboratory in Lexington to obtain fundamental knowledge of the wide range of metals handled by the company.[3]

Beryllium.—Through its affiliate, Beryllium Metals & Chemicals Corp., the Lithium Corp. of America announced that it planned to become the third U.S. producer of beryllium metal.[4] A small pilot plant was planned for Cambridge to perfect processes for producing beryllium metal and beryllium oxide. A commercial plant was to be built later in North Carolina.

Rare-Earth Metals.—Dresser Products, Inc., of Great Barrington, a pioneer in the production and fabrication of metals for nuclear application, reported rapid progress in commercial development of rare-earth metals.[5] These metals were used for atomic power control rods, welding, and metallurgical refinement additives. Vacuum and controlled atmosphere furnaces are required for working the rare earths and other reactive metals. The firm also manufactures zirconium alloy, molybdenum, tungsten, columbium, and other special metals for the chemical and nuclear industries.

REVIEW BY COUNTIES

The Commonwealth of Massachusetts, Department of Public Works, crushed basalt for its own use for concrete aggregate, roadstone, fill, and riprap at quarries and crushers in Bristol, Hampden, Norfolk, and Plymouth Counties. This agency also produced sand and gravel either with its own crews or under contract, chiefly for paving, in every county except Essex and Suffolk.

Barnstable.—Sand and gravel for building construction was processed at a stationary plant near Falmouth by Concrete Products Co. of Cape Cod, Inc. Prepared sand and gravel was produced by Frederick V. Lawrence, Inc., at Falmouth. Unprocessed sand for blast furnace moldings was produced by Whitehead Bros. Co. near Provincetown. Turner & Breivogel, Inc., produced granite riprap at Falmouth Heights.

Berkshire.—State production of lime and limestone was centered in Berkshire County. Lime production by New England Lime Co. at Adams, United States Gypsum Co. at Farnums, and Lee Lime Corp. at Lee decreased 6 percent. Chemical and industrial and construction uses consumed most of the lime produced, but small tonnages of agricultural lime and dead-burned dolomite also were produced. John S. Lane & Son also quarried limestone. Leading among the markets

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[3] Iron Age. V. 188, No. 13, Sept. 28, 1961, p. 66.
[4] Chemical & Engineering News. V. 39, No. 26, June 26, 1961, p. 21.
[5] American Metal Market. V. 68, No. 194, Oct. 9, 1961, pp. 1, 14.

TABLE 5.—Value of mineral production in Massachusetts, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Barnstable	$177,191	$244,538	Sand and gravel, stone.
Berkshire	4,333,785	4,598,970	Lime, stone, sand and gravel.
Bristol	1,970,787	2,351,423	Sand and gravel, stone, clays.
Dukes	(1)	(1)	Sand and gravel.
Essex	2,669,526	2,409,958	Stone, sand and gravel, peat.
Franklin	(1)	691,815	Sand and gravel, stone.
Hampden	(1)	2,383,031	Stone, sand and gravel, clays.
Hampshire	439,345	1,080,278	Sand and gravel, stone.
Middlesex	9,156,381	9,475,049	Stone, sand and gravel.
Nantucket	(1)	(1)	Sand and gravel.
Norfolk	2,902,918	3,361,722	Sand and gravel, stone.
Plymouth	1,287,889	923,420	Sand and gravel, clays, stone.
Suffolk	(1)	304,429	Stone, sand and gravel.
Worcester	1,455,050	2,362,117	Sand and gravel, stone, peat.
Undistributed [2]	3,195,274	47,294	
Total [3]	27,588,146	30,234,044	

[1] Figure withheld to avoid disclosing individual company confidential data; included with undistributed.
[2] Includes sand and gravel and gem stones unspecified by counties and values indicated by footnote 1.
[3] Total adjusted to eliminate duplicating value of stone.

for limestone were agriculture, asphalt filler, whiting, mineral food, and roadstone. Otis Chester Granite Co. quarried rough monumental dimension granite at Otis.

Almost half the gravel produced was used for paving, and almost half the sand produced was used for building material. Nearly 90 percent of the sand and gravel produced at 17 plants was processed by washing or screening. The largest producer of sand and gravel was General Sand & Stone Corp. near Dalton. Other large producers were Berkshire Gravel, Inc., and J. J. Quirico, both at Pittsfield; Abby & Sons at Lee; and Maxymillian, Inc., at Adams.

Bristol.—Sand and gravel production increased 33 percent over 1960. Production from 16 plants was 1.5 million tons, of which 84 percent was washed or screened. Over 60 percent of the gravel and most of the sand produced was used for building purposes, and the remainder was used for paving and fill. Morse Sand & Gravel Co., at Attleboro, was the largest producer. Other large producers were Greenwood & Son at Westport; Assonet Sand & Gravel Co., Inc., at Freetown; Courtois Sand & Gravel Co. at North Attleboro; and Joseph Borge & Sons, Inc., at Swansea. Basalt for concrete aggregate and roadstone was quarried by Warren Bros. Road Co. and Morse Sand & Gravel Co. at Acushnet and Attleboro, respectively. Miscellaneous clay for building brick was mined near Taunton by Stiles & Hart Brick Co.

Dukes.—Production of sand and gravel almost doubled from 1960. Colby Construction Co. continued to produce sand and gravel for building and paving purposes from a stationary plant near Vineyard Haven. New Producers included Grant Bros., Inc., at Edgartown and Goodale Construction Co. at Vineyard Haven.

Essex.—Crushed basalt production decreased 19 percent. Output, reported by Lynn Sand & Stone Co. at Swampscott, by Trimount Bituminous Products Co. at Saugus, and by Essex Bituminous Concrete Corp. at West Peabody, was chiefly for concrete aggregate. Karl A. Persson did not operate his granite quarry in 1961, but Rockport Quarry Co., Inc., continued operation of a quarry at Rockport, producing rough and dressed architectural granite.

Sand and gravel production increased 19 percent over 1960. The largest producer was Andover Sand & Gravel, Inc., producing bank-run gravel at a portable plant near Lawrence. Yemma Bros., Inc., processed large qunatities of sand and gravel at a stationary plant at Groveland. Other large producers were Videtta Corp. at West Peabody and Miles River Sand & Gravel Co. at Ipswich. Essex Sand & Gravel Co., Inc., processed large tonnages of sand for bituminous concrete mixes at a portable plant near Andover.

Andover Sand & Gravel Co. produced peat humus from a bog near Lawrence for bulk sale.

Franklin.—Sand and gravel production increased 71 percent to over 520,000 tons. Zmetra Brothers, the largest operator in the country, leased its Sunderland operation to Warner Bros., Inc., which produced sand and gravel for paving purposes and railroad ballast. Northfield Washed Sand & Gravel Co., Inc., processed sand and gravel at a stationary plant near Northfield. Macksin Sand & Concrete Products produced a large quantity of gravel and a lesser tonnage of sand.

Basalt was quarried at Deerfield by Greenfield Mass. Broken Stone Co. for concrete aggregate, roadstone, and railroad ballast.

Hampden.—John S. Lane & Sons, Inc., continued to operate the Westfield quarry at Deerfield, producing crushed basalt for concrete aggregate, road base, and railroad ballast. The company's West Springfield quarry did not operate in 1961. McCormick Longmeadow Stone Co., Inc., quarried dimension sandstone at East Longmeadow for rubble and dressed building stone. Uses for the building stone included exterior construction at Drew University, Madison, N.J., and Wesleyan University, Middletown, Conn.

Output of sand and gravel decreased. North Wilbraham Sand & Gravel & Concrete Co., Inc., at North Wilbraham and Monson Sand & Gravel Corp. at Monson continued to be the largest producers of processed sand and gravel for building construction. Berkshire Asphalt Co. processed gravel for paving at a portable plant in Springfield. Bay State Sand & Gravel Co., Inc., of Chicopee Falls produced gravel for paving and fill.

Miscellaneous clay for building brick was mined by Westfield Clay Products Co. at Westfield, and Hampshire Brick Co. of Willimansett.

Hampshire.—Production of sand and gravel increased 12 percent over 1960. Bill Willard, Inc., of Northampton was the leading producer. Other large producers included John Omasta of Northampton; Hampshire Sand & Gravel Co. of Westhampton; and D. D. Ruxton Co., Inc., of North Wilbraham. John S. Lane & Son, Inc., quarried basalt at Amherst for concrete aggregate and roadstone.

Middlesex.—The county ranked first in production of both stone and sand and gravel. Dimension granite was quarried in the Westford-North Chelmsford area by five producers, two more than in 1960. H. E. Fletcher was the leading producer. Other producers in order of decreasing output were Morris Bros. Granite Co., Guilmette Bros. Corp. (new operation), Le Masurier Granite Quarry, Inc. (new operation), and Oak Hill Granite Co., Inc. Output was sold for a wide variety of dimension stone products, including building and monumental stone, paving blocks, and curbing and flagging. H. E. Fletcher and Le Masurier also produced crushed granite. Basalt production increased 40 percent, owing to output of a new quarry operated by Massachusetts Broken Stone Co. at Weston. Other producers were J. P. Condon Corp. at Dracut, Rowe Contracting Corp. at Malden, and B. & M. Crushed Stone Co. at Ashland.

Sand and gravel operations increased production, and Middlesex county continued to be the leading producer, with over 25 percent of the State's production. Acme Sand & Gravel Co., Inc., was the largest producer, at a stationary plant near Burlington. San-Vel Contracting Co. at Littleton produced processed sand and gravel. Pomerleau Brothers prepared sand for ice control for several cities near Westford and sand and gravel for building and paving purposes from a stationary plant near Westford. Other large sand and gravel producers were J. J. Cronin Co. at Wilmington, Lexington Sand & Gravel Co. at South Acton, Ashland Sand & Gravel, Inc., at Ashland, County Line Sand & Gravel, Inc., at Berlin, and J. F. Kane & Sons at Hudson.

Vermiculite was exfoliated at North Billerica by The Zonolite Co. for lightweight aggregate and insulation.

Nantucket.—Nantucket Construction Co. produced processed sand and gravel for paving construction at a stationary plant near Nantucket.

Norfolk.—Sand and gravel production increased 29 percent over 1960, with seven operations producing more than 150,000 tons. The leading producer was Highland Sand & Gravel, Inc., at a stationary plant near West Roxbury. Wrentham Sand & Gravel Co., Inc., at Wrentham, A. A. Will Sand & Gravel Corp. at Canton, West Sand & Gravel Co. at Walpole, Boston Sand & Gravel Co. at Canton, Varney Bros. Sand & Gravel, Inc., at Bellingham, and Tresca Brothers Sand & Gravel, Inc., at Newton Center were other large producers of sand and gravel.

Crushed granite production increased 7 percent. Output which was used chiefly as concrete aggregate and roadstone was reported by Old Colony Crushed Stone Co. at Quincy and Simeone Stone Corp. at Wrentham. Dimension granite was quarried by J. S. Swingle, Inc., at Quincy and Bates Bros. Seam Face Granite Co. at Weymouth. The latter company also sold a small quantity of crushed granite. S. M. Lorusso & Sons, Inc., quarried miscellaneous stone at Wrentham for sale for roofing granule manufacture.

Plymouth.—Production of sand and gravel increased to more than 500,000 tons. Boston Sand & Gravel Co. of Scituate was the largest producer; other large producers were Marshfield Sand & Gravel Co. at Marshfield and Petrino Co. at Whitman. Whitehead Bros. Co. processed molding sand at a stationary plant near Marion and Onset.

Clay production increased sharply despite the shutdown of The Bridgewater Brick Co. mine, a large producer in 1960. The Stiles & Hart Brick Co., which had operated only 3 months in 1960, operated a full year in 1961. Output was used entirely for building brick.

Stone production ceased in 1961 as Southeastern Stone Co., Inc., discontinued operations. The company's Taunton basalt quarry was idle, and the Hingham granite quarry was sold to Old Colony Crushed Stone Co. on June 30. The new owners did not operate the quarry during the year.

Suffolk.—Production of crushed basalt for concrete aggregate and roadstone by West Roxbury Crushed Stone Co. was slightly less than in 1960.

D. B. Raymond tripled production of bank-run gravel, which was used chiefly for fill, from a stationary plant near Burlington.

The United States Gypsum Co. calcined imported Nova Scotian gypsum at Charleston. A wide variety of manufactured gypsum products was sold to consumers, chiefly in New England.

The Whittemore Co. Permalite Division expanded perlite at a plant at Roslindale for sale as lightweight aggregate in plaster and concrete and as soil conditioner.

Worcester.—Sand and gravel production increased 38 percent over 1960 to more than 1.9 million tons, with five operations producing over 200,000 tons each. Worcester Sand & Gravel at Shrewsbury was the largest producer of processed and unprocessed sand and gravel. Other large sand and gravel producers were P. J. Keating Co. at Lunenburg, Rosenfeld Washed Sand & Stone Co. near Worcester-Milford, B.N.T. Sand & Gravel Co., Inc., at Worcester, E. L. Dauphinais, Inc., at North Grafton, and De Falco Concrete Corp. at Millbury.

Basalt for concrete aggregate and roadstone was quarried by Holden Trap Rock Co. at Holden and Mario Pandolf Co., Inc., at Sterling. Output increased significantly over that of 1960.

H. E. Fletcher produced high quality dimension granite at Milford for sale as dressed architectural stone.

Penn-Dixie Cement Corp. was constructing bulk storage facilities at Worcester for truck distribution of cement to nearby consumers.

The Mineral Industry of Michigan

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Michigan Department of Conservation, Geological Survey Division, State of Michigan.

By Donald F. Klyce[1]

◆

MINERAL production in Michigan increased in value for the second consecutive year, reaching a new high of $442.7 million, 3 percent above the 1960 record. The mineral fuels group increased 20 percent in value, and construction materials increased nearly 5 percent. Of the latter group, most of the increase was in sand and gravel used in highway construction; cement, clays, and lime increased only slightly in value and gypsum and stone declined below the 1960 level.

Because of a decline in iron ore shipments the value of the metals group was less than in 1960. An increase in copper production was not sufficient to counter the loss in iron ore.

Natural saline minerals (bromine, calcium chloride, iodine, magnesium compounds, potassium, and salt) were nearly 3 percent below the 1960 figure.

Iron ore was first in value, followed by cement, petroleum, sand and gravel, copper, salt, and stone.

Nonmetals (construction materials and natural saline minerals) accounted for 56 percent of the State total.

Employment and Injuries.—Preliminary data for the mineral industries indicated that man-hours worked in the iron-mining industry decreased in 1961, reflecting the decline in iron-ore shipments. The increase of man-hours in the copper-mining and sand and gravel industries paralleled larger production of those commodities. Data represent virtually complete coverage for most mineral commodities.

The Calcite Quarry, Michigan Limestone Division, United States Steel Corp., was awarded the Sentinels of Safety Trophy, the top award, in the quarry group of the 1961 National Safety Competition. This is the second successive year and the eighth time the Calcite Quarry has won the trophy in 34 years of continuous competition.

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[1] Mineral economist, Bureau of Mines, Minneapolis, Minn.

TABLE 1.—Mineral production in Michigan [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland .... thousand 376-pound barrels..	21,187	$73,082	21,948	$75,172
Masonry .... thousand 280-pound barrels..	1,577	4,612	1,515	4,467
Clays .... thousand short tons..	1,738	1,904	1,817	1,975
Copper (recoverable content of ores, etc.)... short tons..	56,385	36,199	70,245	42,147
Gypsum .... thousand short tons..	1,463	5,609	1,295	5,095
Iron ore (usable)..... thousand long tons, gross weight..	10,792	95,791	9,384	87,604
Lime .... thousand short tons..	1,177	15,730	1,211	15,960
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight..	180,460	(2)	17,083	(2)
Natural gas .... million cubic feet..	20,790	4,449	27,697	5,844
Peat .... short tons..	214,402	2,755	209,266	2,002
Petroleum (crude) .... thousand 42-gallon barrels..	15,899	46,266	[3] 18,898	[3] 55,182
Salt .... thousand short tons..	4,088	33,759	3,885	31,284
Sand and gravel [4] .... do....	46,910	39,304	54,603	47,790
Stone .... do....	31,256	32,274	28,731	30,103
Value of items that cannot be disclosed: Bromine, calcium-chloride and calcium-magnesium chloride, gem stones, iodine (1961), magnesium compounds, natural gas liquids, potassium salts, and values indicated by footnote 2	....	45,864	....	46,186
Total Michigan [5]	....	[6] 429,737	....	442,696

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Preliminary figure.
[4] Includes friable sandstone.
[5] Total adjusted to eliminate duplicating value of clays and stone
[6] Revised figure.

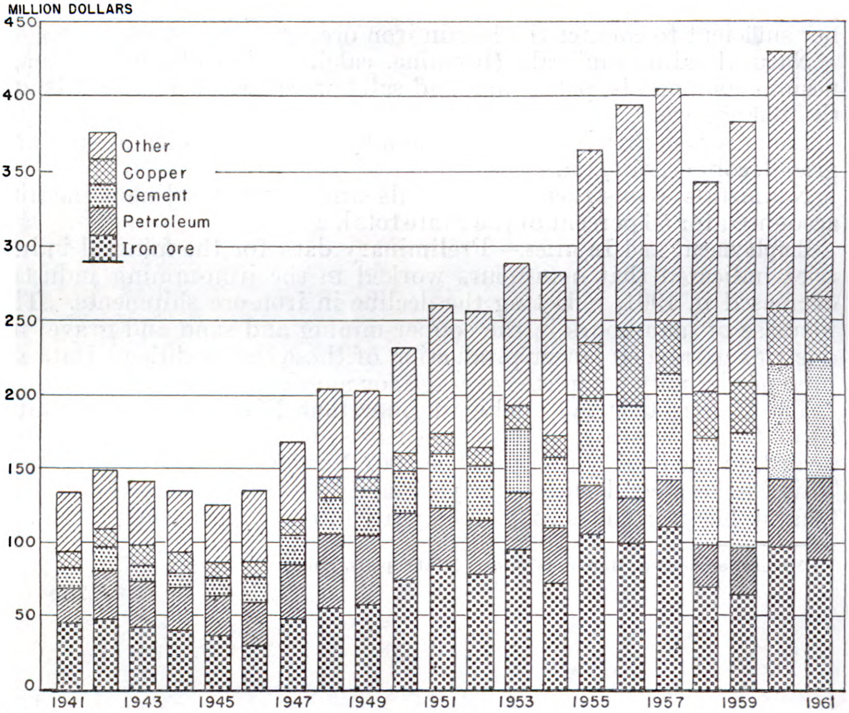

Figure 1.—Value of iron ore, petroleum, cement, and copper, and total value of all minerals in Michigan, 1941–61.

TABLE 2.—Employment and injuries for selected mineral industries[1]

Year and industry	Average number of men working	Total man-hours	Total number of lost-time injuries		Total number days lost or charged	Injury frequency rate[2]	Injury severity rate
			Fatal	Nonfatal			
1960:							
Cement[3]	1,587	4,185,732	1	13	--------	3.35	--------
Clays[4]	255	550,220	--------	23	--------	41.80	--------
Coke ovens	916	2,667,843	1	6	--------	2.62	--------
Copper	1,866	4,166,446	3	128	--------	31.44	--------
Gypsum	473	972,552	--------	4	--------	4.11	--------
Iron ore	5,369	10,240,893	3	292	--------	28.81	--------
Limestone[5]	1,544	2,962,296	--------	36	--------	12.15	--------
Marl	73	44,049	--------	1	--------	22.70	--------
Sand and gravel	2,679	5,171,570	1	99	--------	19.34	--------
Sandstone	23	29,880	--------	1	--------	33.47	--------
Smelters	281	610,427	--------	4	--------	6.55	--------
1961:[6]							
Cement[3]	1,470	3,870,643	--------	20	--------	5.17	--------
Clays[4]	234	515,885	--------	12	--------	23.26	--------
Coke ovens	885	2,550,949	--------	7	--------	2.74	--------
Copper	2,168	5,383,875	1	131	--------	24.51	--------
Gypsum	350	752,863	--------	3	--------	3.98	--------
Iron ore	4,477	7,411,756	1	185	--------	25.10	--------
Limestone[5]	1,434	2,598,357	--------	16	--------	6.16	--------
Marl	72	46,608	--------	--------	--------	--------	--------
Sand and gravel	2,825	5,666,257	1	35	--------	6.35	--------
Sandstone	15	13,286	--------	--------	--------	--------	--------
Smelters	261	639,232	--------	11	--------	17.21	--------

[1] Excludes officeworkers.
[2] Total number of injuries per million man-hours.
[3] Includes cement plants and quarries or pits producing raw material used in manufacturing cement.
[4] Excludes pits producing clay used exclusively in manufacturing cement.
[5] Excludes quarries producing limestone used exclusively in manufacturing cement and lime.
[6] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of cement increased 3 percent in quantity and value, compared with the 1960 figures. The mill value for portland cement was $3.43 per barrel, compared with $3.45 in 1960. Production came from nine plants in seven counties. The total capacity of these operations was about the same as in 1960—31 million barrels. Yearend stocks of portland cement at mills were 2.7 million barrels, 287,000 barrels less than at the beginning of 1961.

Masonry cement was produced at six plants; output was slightly lower than in 1960. The average mill value was $2.95 per barrel compared with $2.92 in 1960. At the beginning of 1961, the reporting of masonry cement was changed from 376-pound barrels to 280-pound barrels. For purposes of comparison, 1960 shipments have been converted to 280-pound barrels.

About 60 percent of the cement shipped was used in the State. Out-of-State shipments went principally to Illinois, Ohio, Wisconsin, and New York, with smaller quantities to Minnesota, North Dakota, Indiana, and Pennsylvania. Over half of the shipments went to ready-mixed concrete companies, while the remainder went principally to concrete-product manufacturers, building-materials dealers, and highway and other contractors. The distribution by type of customer did not change appreciably from 1960.

TABLE 3.—Finished portland cement produced, shipped, and in stock

(Thousand barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills		Stocks at mills, Dec. 31
			Quantity	Value	
1952–56 (average)	7	17,137	17,138	$47,695	1,501
1957	8	21,015	20,590	65,996	2,204
1958	8	19,841	19,691	65,738	2,443
1959	8	21,561	21,682	72,198	2,912
1960	9	20,971	21,187	73,082	[1] 3,023
1961	9	21,661	21,948	75,172	2,737

[1] Revised figure.

Raw materials used in the manufacture of cement included 5.3 million tons of limestone and 1.6 million tons of clay or shale, as well as gypsum, sand, mill scale, pyrite cinders, slag, iron ore, grinding aids, and air-entraining compounds. Over 515 million kilowatt-hours of electrical energy was used at the plants. With one exception, the wet process of manufacture was used.

Clays.—Production of miscellaneous clay and shale was nearly 5 percent higher than in 1960 owing to greater demand for use in cement and heavy clay products (brick, draintile, and sewer pipe). Over 86 percent of the output was used in cement plants. The remainder was used principally in manufacturing heavy clay products, lightweight aggregate, and pottery.

Clay was mined in 10 counties at 16 sites. The largest production was reported from Alpena, Wayne, Saginaw, Monroe, and St. Clair Counties.

Gem Stones.—Collection of alabaster, agate, native copper specimens, datolite, dolomite, and thomsonite was reported. Most of the material was found in Keweenaw and Ontonagon Counties.

Gypsum.—Gypsum was mined from quarries in Iosco County and underground mines in Kent County. The crude material was processed at plants in National City, Grand Rapids, and Detroit and also was shipped to plants in Illinois and Ohio. Plasterboard, exterior sheathing, lath, and plaster were the principal products manufactured. Decreased demand for building materials adversely affected the output of both crude and calcined gypsum. The former was down nearly 12 percent, and the latter, 14 percent, from 1960 levels.

Lime.—Lime was produced in 12 counties. The largest output came from Wayne and Mason Counties. In 1961 several papermills and sugar plants, which had not been canvassed previously, reported captive production. Over 80 percent of the lime output was used by the producers. Chemical, metallurgical, paper, water treatment and sugar plants, were the principal markets for the lime produced. About 3 percent of the lime manufactured was hydrated; the balance was quicklime. Production was 3 percent higher than in 1960, but much of this came from plants not previously canvassed. Annual lime-burning capacity of the plants reporting exceeded 1.6 million tons.

Natural Salines.—Bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash were extracted from natural well brines at plants in Gratiot, Lapeer, Mason, Manistee, and Midland Counties. The value of the output was about the same as in 1960.

Perlite.—Expanded perlite was produced at plants in National City and Grand Rapids from crude ore mined in Colorado and Nevada. Most of the material was used in building plaster. Shipments reflected the decline in demand for building materials and were nearly 20 percent less than in 1960.

Salt.—Salt was produced from natural well brines, from artificial brines formed by dissolving salt from the Salina formation, and from one underground mine. Ten plants in six counties reported production. The largest production came from Wayne County, with three operations, including the underground mine of International Salt Co.

Production was 5 percent less than in 1960. Much of the loss was due to smaller purchases of salt for highway ice control. Salt was used principally in chemical manufacture (chlorine and soda ash) and for highway ice control; other uses were for meat packing and food processing, table salt, animal food, water treatment, paper, and textile manufacturing.

Sand and Gravel.—Sand and gravel was produced throughout the State. Because of transportation costs and the low value of the material (except for industrial sands), production was concentrated near the markets in large centers of population. Nearly a third of the total was produced in the Detroit area (Livingston, Macomb, Oakland, Washtenaw, and Wayne Counties). Large tonnages also were reported from Kent, Genesee, Ingham, Jackson, Kalamazoo, Calhoun, and Muskegon Counties.

Output of sand and gravel was 16 percent more than in 1960. Much of the increase was due to a greater demand for road materials, particularly base course construction in the State highway program. Industrial sands (molding, glass, blasting, grinding, and polishing) were also in greater demand. Consumption for building construction remained near the 1960 level, while that for fill material declined slightly.

Over 51 million tons of sand and gravel was moved by truck, and the balance, by rail and water. Production was reported from 261 commercial operations and 130 Government-and-contractor operations. Of the commercial operations, the output of four exceeded 1 million tons each and accounted for 21 percent of the commercial tonnage. Of the remainder, 12 percent was from 7 plants of 500,000 to 1 million tons; 29 percent, from plants of 250,000 to 500,000 tons; and 23 percent, from 55 plants of 100,000 to 250,000 tons; while 15 percent of the total was produced in 164 plants of less than 100,000 tons.

Stone.—Limestone was the principal stone quarried; basalt, marl, and sandstone also were produced. Limestone was quarried and crushed in 16 counties by 21 commercial producers and by 3 county highway agencies. The bulk of the tonnage came from large quarries in an area bordering Lakes Huron and Michigan in the northern part of the State. From company-operated ports, nearly 23 million tons was moved by water to cement and lime plants, steel mills, and other industrial consumers. Crushed stone production was 8 percent less than in 1960. Most of the decline was caused by smaller demand from industrial consumers, principally steel and cement mills. Of the 28.5 million tons of crushed limestone produced, 10.6 million tons was used for flux; 12.6 million tons, for chemicals, cement, and lime manufacture; and 4.6 million tons, for highway use. The remaining tonnage was used principally for agricultural purposes.

A small tonnage of dimension limestone was produced. Most of it was used for rubble, rough construction, and flagging.

TABLE 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand: [1]				
Molding	1,699	$2,719	1,693	$2,498
Building	4,095	3,179	4,427	3,428
Paving	4,701	4,091	5,234	4,694
Engine	54	68	46	59
Fill	1,959	764	2,361	855
Other	10	5	43	30
Undistributed [2]	610	1,558	830	2,014
Total [3]	13,128	12,384	14,633	13,578
Gravel:				
Building	4,520	5,319	4,343	5,179
Paving	15,642	13,952	20,220	17,194
Railroad ballast	170	185	112	119
Fill	507	289	307	217
Other	59	42	52	60
Total [3]	20,898	19,787	25,034	22,770
Total sand and gravel [3]	34,026	32,171	39,668	36,348
Government-and-contractor operations:				
Sand:				
Building	1	1	----------	----------
Paving	929	410	1,567	882
Fill	1,193	370	1,028	408
Other	----------	----------	40	19
Total	2,123	781	2,635	1,309
Gravel:				
Building	27	13	38	21
Paving	10,338	6,228	11,795	9,936
Fill	396	111	305	105
Other	----------	----------	163	71
Total	10,761	6,352	12,301	10,133
Total sand and gravel	12,884	7,133	14,936	11,442
All operations:				
Sand	15,251	13,165	17,268	14,887
Gravel	31,659	26,139	37,335	32,903
Grand total	46,910	39,304	54,603	47,790

[1] Includes friable sandstone.

[2] Includes railroad ballast (1960), blast, glass, grinding and polishing, and other ground and unground industrial sands.

[3] Data do not add to totals shown owing to rounding.

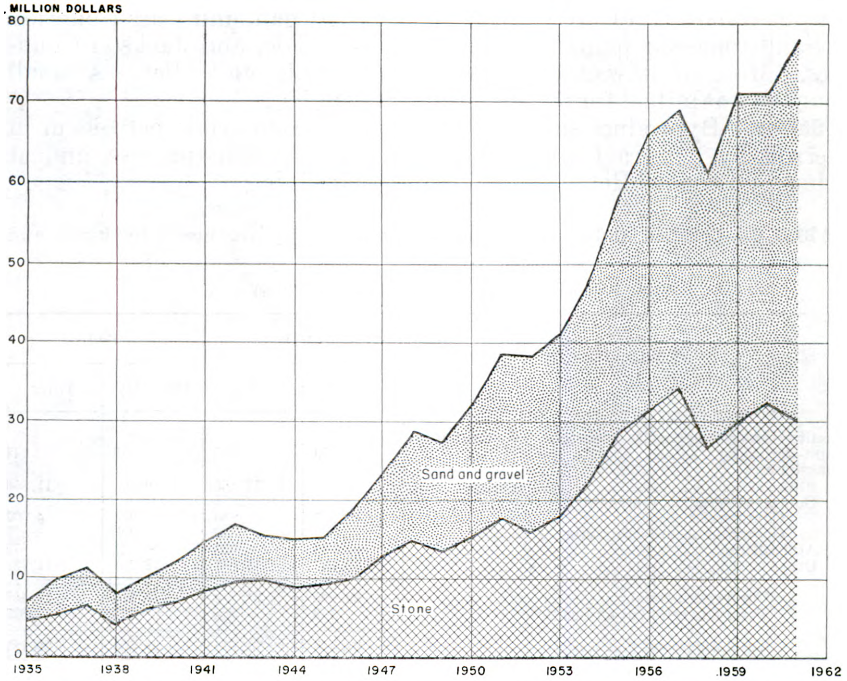

FIGURE 2.—Value of sand and gravel and stone in Michigan, 1935–61.

TABLE 5.—Dimension stone sold or used by producers, by kinds

Year	Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1957	34,741	$105,854	17,889	$70,142	52,630	$175,996
1958	50,965	120,361	18,776	132,981	69,741	253,342
1959	6,503	58,120	21,779	154,510	28,282	212,630
1960	6,801	58,889	11,615	97,395	18,416	156,284
1961	27,516	119,950	7,045	54,057	34,561	174,007

The largest producers of limestone, in alphabetical order, were:

Drummond Dolomite, Inc. (Chippewa County)
The Dundee Cement Co. (Monroe County)
The France Stone Co. (Monroe County)
Huron Portland Cement Co. (Alpena County)
Inland Lime & Stone Co. (Mackinac County)
Michigan Foundation Quarry Co., Inc. (Wayne County)
Michigan Limestone Div. of U.S. Steel Corp. (Mackinac and Presque Isle Counties)
Penn-Dixie Cement Corp. (Emmet County)
Presque Isle Corp. (Presque Isle County)
The Wallace Stone Co. (Huron County)

Basalt was quarried and crushed for road use in Houghton County.

Marl was produced in 16 counties by 38 producers for soil conditioning. The output was about the same as in 1960. Principal output came from Calhoun, Kalamazoo, Allegan, and Cass Counties.

Sandstone was quarried in Baraga, Hillsdale, and Jackson Counties. Most of it was used for riprap, rubble, and filler. A small tonnage was milled for building use and flagging.

Sulfur.—Byproduct sulfur was recovered from crude petroleum in Detroit by Aurora Gasoline Co. using the Parsons process, and at Alma by Leonard Refinery, Inc., using hydrofining.

TABLE 6.—Crushed and broken stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1960		1961	
	Quantity	Value	Quantity	Value
Basalt: Concrete aggregate, roadstone: Government-and-contractor	50	$56	26	$41
Limestone:				
Flux	12,292	13,165	10,565	11,856
Concrete aggregate, roadstone:				
Commercial	5,063	5,830	4,356	4,997
Government-and-contractor	363	398	293	327
Agriculture	573	931	521	872
Other [1]	12,737	11,647	12,768	11,730
Total commercial	30,665	31,573	28,210	29,455
Total Government-and-contractor	363	398	293	327
Total limestone [2]	31,028	31,971	28,504	29,782
Marl, calcareous: Agriculture	160	91	157	100
Sandstone: Riprap, filler, foundry	----------	----------	10	7
Total commercial [2]	30,825	31,664	28,377	29,561
Total Government-and-contractor	413	454	319	368
Grand total [2]	31,238	32,118	28,697	29,929

[1] Includes limestone for riprap, railroad ballast, chemical uses, whiting or whiting substitutes, asphalt filler, dust for coal mines, mineral food, poultry grit, stone sand, cement, lime, and other miscellaneous purposes.

[2] Data do not add to totals shown because of rounding.

METALS

Metals accounted for 29 percent of the total value of mineral production, compared with 31 percent in 1960.

Copper.—Production of copper in terms of recoverable metal was nearly 25 percent more than in 1960. Because of lower prices, the value of the output increased only 16 percent. Production remained stable throughout the year with only minor monthly variations. Output was reported from nine underground mines, two tailing dumps, and three tailing reclamation plants.

Calumet & Hecla, Inc., operated seven mines, two tailing dumps, one reclamation plant, and one smelter in Houghton and Keweenaw Counties. Copper Range Co. operated the Champion mine and the Freda mill, in Houghton County. The mill concentrated ore from the mine and tailing from the Redridge sands. Concentrate from the mill was processed at the White Pine Copper Co. smelter in Ontonogan County. Quincy Mining Co. operated a reclamation plant and smelter in Houghton County. White Pine Copper Co. operated a mine, mill, and smelter in Ontonagon County.

The average weighted price of copper decreased to 30.0 cents from 32.1 cents per pound in 1960. The price quoted by primary producers for electrolytic copper (delivered) opened in 1961 at 30 cents a pound, dropped to 29 cents on January 17, rose to 30 cents on May 1, and rose again to 31 cents on May 19, where it remained for the balance of the year.

TABLE 7.—Mine production of copper in 1961, by months, in terms of recoverable metal

Month	Short tons	Month	Short tons
January	5,510	August	5,545
February	5,635	September	5,980
March	6,075	October	6,300
April	5,655	November	6,185
May	5,405	December	6,170
June	6,265		
July	5,520	Total	70,245

TABLE 8.—Mine production of copper, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailing	Ore (short tons)	Tailing (short tons)	Short tons	Value
1952-56 (average)	11	2	3,683,686	1,880,899	36,196	$25,580,040
1957	14	3	5,939,034	2,369,546	58,400	35,156,800
1958	11	2	5,957,879	1,336,077	58,005	30,510,630
1959	10	3	5,666,533	1,940,455	55,300	33,954,200
1960	9	3	5,600,290	2,192,818	56,385	36,199,170
1961	10	3	7,109,924	2,122,286	70,245	42,147,000

Iron Ore.—Shipments of iron ore from Michigan mines were 13 percent (1.4 million long tons) less than in 1960. Competition from high-iron content concentrates and from foreign ores, plus the high cost of underground mining, and the lack of demand from the steel industry were given as reasons for shutting down or curtailing production at several Michigan iron ore mines. Two underground and two open-pit mines which operated in 1960 did not open in 1961, and three underground mines were closed during the year. A total of 20 underground and three open-pit mines were active all or part of the year.

According to a study by the Michigan Department of Conservation,[2] the average mining cost per ton (delivered at Lake Erie ports) for underground mines was $10.64 in 1961, compared with $10.69 in 1960. Labor cost dropped to $2.77 a ton from $3.07 and supplies, to $1.40 from $1.42. Taxes (excluding Federal income tax) increased from $0.60 to $0.73; general overhead, from $1.16 to $1.38; and marketing, from $0.07 to $0.08. Transportation cost remained at $3.11.

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[2] Geological Survey Division, Michigan Department of Conservation. General Statistics Covering Costs and Production of Michigan Iron Mines. June 1961, p. 7.

TABLE 9.—Crude iron ore[1] data, in 1961, by counties and ranges

(Thousand long tons)

County and range	Stocks of crude ore, Jan. 1	Production		Shipments		Stocks of crude ore, Dec. 31
		Underground	Open pit	Direct to consumers	To beneficiation plants	
County:						
Dickinson		----	1,488	9	1,479	----
Gogebic	1,092	1,062	----	1,362	----	791
Iron	810	3,354	----	3,096	----	1,067
Marquette	1,932	2,864	3,405	1,574	4,641	1,987
Total[2]	3,833	7,280	4,893	6,041	6,120	3,845
Range:						
Gogebic	1,092	1,062	----	1,362	----	791
Marquette	1,932	2,864	3,405	1,574	4,641	1,987
Menominee	810	3,354	1,488	3,105	1,479	1,067
Total[2]	3,833	7,280	4,893	6,041	6,120	3,845

[1] Exclusive of iron ore containing 5 percent or more manganese.
[2] Data do not add to totals shown owing to rounding.

TABLE 10.—Usable iron ore shipped from mines, by ranges[1]

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total
1952–56 (average)	5,218	4,137	2,941	12,296
1957	5,993	4,297	2,833	13,123
1958	3,722	2,995	1,394	8,111
1959	3,530	2,469	1,249	7,247
1960	4,881	4,018	1,892	10,792
1961	4,141	3,881	1,362	9,384

[1] Exclusive of iron ore containing 5 percent or more manganese, natural.

TABLE 11.—Usable iron ore produced, by ranges[1]

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total
1952–56 (average)	5,281	4,130	2,934	12,346
1957	6,557	4,201	2,868	13,626
1958	4,111	2,896	1,397	8,404
1959	2,851	2,616	1,663	7,129
1960	6,619	4,079	2,169	12,866
1961	3,205	4,097	1,062	8,364
Total 1854–1961	312,641	[2] 258,774	[2] 245,345	816,760

[1] Exclusive of iron ore containing 5 percent or more manganese, natural.
[2] Distribution by range partly estimated before 1906.

On the Gogebic range delivered costs per ton average $13.79 in 1961, compared with $11.80 in 1960; on the Marquette range costs increased to $11.10 from $10.88; and on the Menominee range costs decreased from $9.87 to $9.49. The closing of some underground mines on the Menominee range probably reduced the average cost, both for the range and for the State.

About 40 percent of the ore mined in 1961 came from open-pit operations, and the balance came from underground mines. Average iron content of usable ore produced was 54.88 percent, natural.

The trend toward the use of concentrate from jaspilite ore was accelerated during 1961, as steel mills showed a preference for higher quality materials for blast furnace feed. Over 25 percent of iron ore shipments were from this source, compared with 11.6 percent in 1960.

The average weighted mine value of Michigan iron ore, without respect to grade, was $9.34 per long ton, compared with $8.88 per long ton in 1960.

Most of the Michigan iron ore was shipped to producers of pig iron and steel, except for a small tonnage used in the manufacture of iron oxide pigments. About 96 percent of the iron ore shipped went by rail to ore docks in Ashland, Wis., and Escanaba and Marquette, Mich., and then by boat to lower Lake ports. The balance was all-rail shipments to consuming districts.

The Lake shipping season for Michigan ores opened at Escanaba and Marquette on April 24 and closed at Marquette on December 4.

The North Range Mining Co. applied to the Area Redevelopment Administration for assistance in mine development and construction of a pelletizing plant.

At yearend estimated reserves of iron ores in Michigan totaled 111 million tons,[3] not including about 1.8 billion tons[4] of low-grade hematite ore.

Manganiferous Ore.—The Cannon mine in Iron County shipped manganiferous ore (containing 5 to 35 percent manganese, natural). The ore was sold as an iron ore, and a premium was paid for the contained manganese.

TABLE 12.—Manganiferous iron ore (containing 5 to 10 percent manganese, natural) and ferruginous manganese ore (containing 10 to 35 percent manganese, natural) shipped from mines

Year	Long tons	Year	Long tons
1952–56 (average)	20,305	1959	------------
1957	110,310	1960	161,125
1958	100,479	1961	15,253

Pig Iron and Steel.—Pig-iron and steel manufacture was centered in the Detroit area. According to the American Iron and Steel Institute, Michigan steel production totaled 6.7 million tons, a slight increase over the 1960 output. Pig-iron shipments increased 6 percent in volume and 3 percent in value over the 1960 figures. Basic and Bessemer grades were produced.

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[3] Work cited in footnote 2.

[4] Pardee, F. G., and B. E. Kennedy. Low-Grade Ore Occurrences in Michigan. Univ. of Minnesota, 9th Ann. Min. Symp. 1948, p. 24.

Construction progressed on the Great Lakes Steel Corp. 80-inch rolling mill in River Rouge. In a 2,160-foot-long building, steel will be rolled at the rate of 3,000 feet a minute.

MINERAL FUELS

Natural Gas and Natural Gas Products.—About three-fifths of the State gas production came from oil well gas; the balance came from gasfields. A third of the output came from the oilfields of the Albion-Pulaski-Scipio trend in Calhoun, Jackson, and Hillsdale Counties. A quarter of the total came from Allegan County, principally from the Salem gasfield. Other major gas-producing areas were in Roscommon, St. Clair, and Wayne Counties. The above areas yielded 77 percent of the total. The remainder came from fields in 21 counties. Nine new gasfields were developed during the year, while four fields were abandoned.

Peat.—Peat production was slightly less than in 1960, but Michigan remained the largest producer of peat in the Nation, accounting for 40 percent of the total. Although peat was produced in 16 counties, 95 percent of the output came from bogs in Lapeer, Oakland, St. Clair, and Sanilac Counties. The peat was sold principally for soil improvement. None was sold as a fuel.

Petroleum.—Petroleum production again increased over the preceding year. However, the increase of 19 percent failed to match the 50-percent increase registered in 1960. Nearly three-fifths of the production came from fields in the Albion-Pulaski-Scipio Trend in Calhoun, Hillsdale, and Jackson Counties, where output was 3.3 million barrels higher than in 1960. Production in St. Clair County doubled to 816,000 barrels. According to data published by the Oil and Gas Section, Geological Survey Division, Michigan Department of Conservation, permits for exploratory and development wells declined from 824 in 1960 to 769, excluding service wells, reworks, and deepenings. Footage drilled totaled 2.3 million feet, compared with nearly 3 million feet in 1960. Exploratory footage increased to 1,002,000 feet from 963,000 feet in 1960, while development footage declined to 1,307,000 feet from 2,011,000 feet. The area of greatest drilling activity was in eastern Michigan (St. Clair and Macomb Counties), where 69 oil wells and 36 gas wells were completed during the year. Increased exploration of the Niagara reefs of the Silurian system in this area, noted during the latter part of 1960, continued. Of the 19 discovery wells (oil and gas) reported in 1961, 10 were in Macomb and St. Clair Counties.

Petroleum was produced in 45 counties, all in the lower peninsula. Fourteen crude oil refineries, with a nominal rated capacity of 192,000 barrels daily, were operated.

Fluid injection was reported in 40 percent of the 179 active oilfields. Nearly 45 million barrels of fluid and 900 million cubic feet of gas were injected into producing formations through 260 wells. Of the total fluid injected, 41 million barrels was brine, 3 million barrels was a mixture of brine and fresh water, and 1 million barrels was fresh water. From the same fields, 49.5 million barrels of fluid, nearly all brine, was produced. One quarter of the State oil output and one-eighth of the gas production came from these fields.

REVIEW BY COUNTIES

Mineral production was reported from all but one (Benzie) of the 83 counties in Michigan. The value of output increased in 45 counties and declined in 38 counties. Output exceeded $1 million in 43 counties. Marquette County led in value of production, as it did in 1960.

Sand and gravel was produced in 80 counties and was the only mineral reported in 7 counties.

TABLE 13.—Value of mineral production in Michigan, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Alcona	$89,600	$172,773	Sand and gravel.
Alger	94,123	143,345	Do.
Allegan	1,128,405	[2] 1,249,805	Sand and gravel, petroleum, peat, stone, natural gas.
Alpena	36,093,544	(3)	Cement, stone, clays, sand and gravel.
Antrim	(3)	(3)	Clays, sand and gravel.
Arenac	1,649,178	1,462,102	Petroleum, stone, sand and gravel.
Baraga	353,612	393,301	Iron ore, sand and gravel, stone.
Barry	513,816	521,292	Sand and gravel, petroleum, stone.
Bay	10,454,259	9,654,803	Cement, petroleum, lime, sand and gravel.
Benzie	780	----------	
Berrien	1,125,122	981,318	Sand and gravel, stone.
Branch	406,509	529,333	Do.
Calhoun	7,632,465	[2] 12,085,596	Petroleum, sand and gravel, stone, natural gas.
Cass	262,710	387,090	Sand and gravel, petroleum, stone.
Charlevoix	53,761	62,900	Sand and gravel, stone.
Cheboygan	208,747	220,436	Do.
Chippewa	4,525,614	5,196,187	Stone, lime, sand and gravel.
Clare	1,265,076	[2] 1,831,711	Petroleum, sand and gravel, natural gas.
Clinton	284,905	455,664	Sand and gravel, clays, peat.
Crawford	626,437	[2] 808,914	Petroleum, sand and gravel, natural gas.
Delta	418,482	472,362	Sand and gravel, stone.
Dickinson	5,477,161	7,272,644	Iron ore, sand and gravel, stone.
Eaton	420,860	492,250	Sand and gravel, stone, clays, peat.
Emmet	12,198,884	11,167,650	Cement, stone, sand and gravel.
Genesee	775,647	847,373	Sand and gravel, petroleum.
Gladwin	1,306,823	1,246,690	Petroleum.
Gogebic	16,452,545	12,478,611	Iron ore, sand and gravel.
Grand Traverse	(3)	(3)	Sand and gravel.
Gratiot	(3)	(3)	Salines, salt, petroleum, sand and gravel, natural gas.
Hillsdale	11,132,708	[2] 12,804,588	Petroleum, sand and gravel, stone, natural gas.
Houghton [4]	36,666,653	42,453,323	Copper, sand and gravel, stone.
Huron	926,367	879,976	Stone, sand and gravel, lime, petroleum.
Ingham	1,007,588	956,703	Sand and gravel, lime, peat.
Ionia	401,799	344,552	Sand and gravel, petroleum.
Iosco	(3)	(3)	Gypsum, sand and gravel.
Iron	29,673,583	25,942,454	Iron ore, sand and gravel, manganiferous ore.
Isabella	2,560,101	[2] 2,217,045	Petroleum, sand and gravel, stone, natural gas.
Jackson	5,585,970	[2] 9,719,086	Do.
Kalamazoo	629,399	817,328	Sand and gravel, stone, peat, petroleum.
Kalkaska	120,457	[2] 223,985	Sand and gravel, petroleum, natural gas.
Kent	3,056,652	[2] 3,432,473	Sand and gravel, gypsum, petroleum, peat, natural gas.
Keweenaw	(5)	(5)	Copper, sand and gravel.
Lake	55,611	95,313	Sand and gravel, petroleum.
Lapeer	1,057,142	1,064,994	Peat, sand and gravel, salines.
Leelanau	64,862	159,773	Sand and gravel.
Lenawee	3,498,460	3,134,742	Cement, sand and gravel, clays, petroleum, peat.
Livingston	2,473,640	[2] 2,665,880	Sand and gravel, petroleum, natural gas.
Luce	28,239	31,235	Sand and gravel.
Mackinac	(3)	(3)	Stone, sand and gravel.
Macomb	1,221,721	[2] 878,618	Sand and gravel, petroleum, natural gas.
Manistee	11,362,760	12,884,178	Salines, salt, sand and gravel, lime.
Marquette	45,998,909	43,414,822	Iron ore, sand and gravel.
Mason	(3)	(2 3)	Salines, lime, sand and gravel, petroleum, natural gas.

See footnotes at end of table.

TABLE 13.—Value of mineral production in Michigan, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Mecosta	$244,118	[2] $237,705	Sand and gravel, petroleum, stone, natural gas.
Menominee	952,637	1,133,396	Lime, sand and gravel.
Midland	(3)	(2 3)	Salines, salt, petroleum, sand and gravel, potash, iodine, natural gas.
Missaukee	2,525,426	[2] 2,465,567	Petroleum, sand and gravel, natural gas.
Monroe	(3)	(3)	Cement, stone, clays, petroleum, peat.
Montcalm	2,399,188	[2] 1,755,878	Petroleum, sand and gravel, peat, natural gas.
Montmorency	15,921	208,276	Sand and gravel, petroleum.
Muskegon	1,878,896	[2] 1,910,920	Sand and gravel, salt, lime, petroleum, natural gas.
Newaygo	257,699	[2] 231,398	Petroleum, sand and gravel, stone, natural gas.
Oakland	5,257,064	[2] 6,078,686	Sand and gravel, peat, petroleum, natural gas.
Oceana	790,922	[2] 863,116	Petroleum, sand and gravel, natural gas.
Ogemaw	1,562,681	[2] 1,412,817	Do.
Ontonagon	(5)	(5)	Copper, sand and gravel.
Osceola	1,920,351	[2] 1,721,843	Petroleum, sand and gravel, stone, natural gas.
Oscoda	43,537	23,025	Sand and gravel, petroleum.
Otsego	37,291	[2] 1,085,806	Sand and gravel, natural gas.
Ottawa	2,712,552	2,031,077	Sand and gravel, petroleum, stone.
Presque Isle	(3)	(3)	Stone, sand and gravel.
Roscommon	1,489,098	[2] 1,256,706	Petroleum, sand and gravel, natural gas.
Saginaw	709,779	603,724	Clays, petroleum, sand and gravel, lime.
St. Clair	14,165,260	[2] 15,904,394	Salt, petroleum, cement, peat, sand and gravel clays, natural gas.
St. Joseph	162,167	(3)	Sand and gravel, stone, peat.
Sanilac	1,206,419	563,388	Sand and gravel, peat, lime.
Schoolcraft	137,719	262,067	Sand and gravel.
Shiawassee	460,008	547,484	Sand and gravel, clays.
Tuscola	1,906,107	1,959,030	Sand and gravel, petroleum, lime, peat.
Van Buren	352,409	342,378	Sand and gravel, petroleum, stone.
Washtenaw	1,749,766	[2] 3,652,860	Sand and gravel, petroleum, peat, natural gas.
Wayne	45,061,398	[2] 40,031,488	Cement, salt, lime, sand and gravel, stone, clays, petroleum, natural gas.
Wexford	97,949	64,983	Sand and gravel.
Undistributed[6]	88,161,442	130,208,323	
Total[7]	[8] 429,737,000	442,696,000	

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[1] Gem stones and natural gas liquids not listed by counties as data are not available, included with "Undistributed."

[2] Excludes value of natural gas.

[3] Figure withheld to avoid disclosing individual company confidential data.

[4] Includes value of mineral production in Keweenaw and Ontonagon Counties.

[5] Value of mineral production is included in that of Houghton County.

[6] Includes petroleum (1960), some sand and gravel not assigned to specific counties, and values indicated by footnotes 1 and 3.

[7] Total adjusted to eliminate duplicating value of clays and stone.

[8] Revised figure.

Allegan.—Sand and gravel, petroleum, and natural gas were the principal minerals reported. Small quantities of marl and peat, for soil conditioning and horticultural use, were produced. The Salem gasfield again was the largest in the State, with an output of over 5 billion cubic feet. Sand and gravel was mined from nine sites. Most of the material was used in road construction.

Alpena.—Portland and masonry cements were manufactured at Alpena by Huron Portland Cement Co. The company announced plans to double the capacity of existing facilities, over a period of 14 years. Work progressed on a new rotary kiln, as well as on new crushing and drying facilities. The *Huron*, formerly an oil tanker, was being converted to a cement and coal carrier. It was to have a capacity of 55,000 barrels, the largest on the Great Lakes.

Limestone and clay for cement and sand and gravel for highway use were produced in the Alpena area.

Antrim.—Shale was mined from the Ellsworth quarry by Penn-Dixie Cement Co. for use at its Petoskey cement plant. The county road commission produced gravel for road use.

Arenac.—Petroleum was produced at seven fields, with the largest yields coming from the Deep River and Sterling fields. Limestone for road use was quarried and crushed by the Arenac County and Bay County Road Commissions. Materials for building and road construction were obtained from three sand and gravel pits.

Baraga.—Cleveland-Cliffs Iron Co. produced iron ore from the Ohio open pit. Sandstone was quarried and milled for use as building stone by DeRoche Brothers of Keweenaw Bay, who operated the DeRoche quarry, and by Superior Natural Red Stone Quarry (Arnheim). Gravel for road use was produced by the county road commission and the State highway department.

Barry.—Sand and gravel was produced at fixed plants near Hastings, Nashville, and Wayland and by portable plants throughout the county. The material was used chiefly for building and paving, although some was used for ice control (sand) and fill. Marl pits were operated near Caledonia and Nashville. Petroleum was obtained from the Hope and Johnstown fields. The Thornapple field was abandoned in 1961.

Bay.—Masonry and portland cements were manufactured at Bay City by Aetna Portland Cement Co. Monitor Sugar Division of Robert Gage Coal Co. produced lime for its own use. Petroleum was produced from seven fields, with the major portion coming from the Kawkawlin field. The Beaver field was abandoned during the year. The State highway department produced road gravel.

Berrien.—Industrial sand (principally molding sand) was produced at Bridgman by Arrowhead Silica Corp. and at Sawyer by the Manley Sand Division of Martin Marietta Corp. and by Producers Core Sand Corp. Building and road materials also were mined from several sand and gravel pits in the county. A small quantity of marl was obtained from pits near Three Oaks.

Branch.—Sand and gravel output from five pits was used for building and paving purposes and fill. Marl was produced near Quincy for agricultural purposes.

Calhoun.—Over 3.9 million barrels of petroleum was produced from fields of the Albion-Pulaski-Scipio trend, 1.5 million barrels more than in 1960. Calhoun County with adjoining Hillsdale and Jackson Counties continued to be the most productive section of the State, contributing nearly 60 percent of the 1961 petroleum production. Oil well gas from county wells totaled nearly 3 billion cubic feet, the third largest production in the State.

Over 750,000 tons of sand and gravel was produced by commercial operators and county and State agencies, mostly for building and road construction. Marl was obtained from five pits near Burlington, Marshall, Sherwood, and Union City.

Cass.—Petroleum production was reported from the Jefferson field. This was the first year significant production was recorded. The county was the scene of considerable drilling activity, with 54 permits issued; 12 oil wells were completed and 31 dry holes were drilled.

Sand and gravel was produced at five sites. Marl was dug from pits near Cassopolis, Dowgiac, and Jones.

Charlevoix.—A limestone quarry was operated near Charlevoix by Charlevoix Lime & Stone Co. The output was used for rough construction, flux, roadstone, and agricultural purposes. Sand and gravel was produced by the county and State highway departments.

Cheboygan.—Limestone was quarried and crushed at Afton by Afton Stone and Lime Co. for concrete aggregate and roadstone. Sand and gravel was obtained at three sites for building and paving use.

Chippewa.—Drummond Dolomite, Inc., quarried and crushed limestone on Drummond Island for use as flux, concrete aggregate, roadstone, and agricultural limestone. During the year a new quarry on Huron Bay on the island's south shore was put into production by the company. Sand and gravel was produced by I. L. Whitehead Co., Sault Sainte Marie, and by the county and State highway departments.

Clare.—Production of nearly 450,000 barrels of petroleum came from nine fields. Over 200 million cubic feet of gas was produced, most of it oil-well gas from the North Hamilton field. The State highway department contracted for over 600,000 tons of gravel from county pits.

Clinton.—Grand Ledge Clay Products Co. mined miscellaneous clay for manufacturing vitrified sewer pipe. Humus peat was produced from a bog near Ovid. Nearly 700,000 tons of sand and gravel was produced by commercial operators and county and State agencies. It was used for fill and building and paving.

Crawford.—Petroleum and natural gas were produced from the Crawford County portion of the Beaver Creek field. Sand and gravel production for road use was reported by the county and State highway departments and by one commercial operator. Output was double that of 1960.

Delta.—Limestone was quarried and crushed by Bichler Bros. of Escanaba for concrete aggregate and roadstone. Sand and gravel output of eight pits was used mostly for road construction and maintenance.

Dickinson.—The Hanna Mining Co. operated the Groveland open-pit iron mine. The jaspilite ore was concentrated at a plant near Randville. During the year the company announced an expansion program to increase the capacity of the Groveland concentrating plant from 700,000 to 1,500,000 tons a year and to add facilities that will produce 1,250,000 tons of pellets annually. The pellets will contain lime, magnesia, and more than 60 percent iron, and they will be the first partially fluxed pellets for sale on the U.S. iron ore market.

Metro-Nite Co. quarried limestone near Felch and shipped it to its Wisconsin mill, where it was processed and sold as paint and putty filler. Superior Rock Products Co. operated the Randville quarry and produced crushed limestone that was used in terrazzo and ornamental concrete. Road materials were produced from three sand and gravel pits.

Eaton.—Vitrified sewer pipe was manufactured from miscellaneous clay, mined near Grand Ledge, by American Vitrified Products Co. and Grand Ledge Clay Products Co. Cheney Limestone Co. operated a quarry at Bellevue and produced rubble, roadstone, and agricultural limestone. Sand and gravel, used mostly for fill and building and paving, was mined at 11 sites.

Reed-sedge peat was dug from a bog near Charlotte by Hilu Peat Co.

Emmet.—Penn-Dixie Cement Corp. produced portland and masonry cements at its Petoskey plant. Limestone was quarried near the plant for use in manufacturing cement. The State highway department had paving gravel produced under contract at three sites.

Genesee.—Over 1 million tons of sand and gravel was produced by 16 operators. It was used principally for fill and building and paving. Petroleum was produced from the Otisville field.

Gladwin.—Petroleum production was reported from eight fields, with the largest output coming from North Buckeye field. About 427,000 barrels was produced, compared with 445,000 barrels in 1960.

Gogebic.—North Range Mining Co. operated the Penokee underground iron mine until December 1, when it was closed. Pickands Mather and Co. operated the Geneva-Newport, Peterson, and Sunday Lake mines. Operations at the Sunday Lake mine were suspended on February 16, and the Peterson mine was shut down for 7 months during the year. A drying plant was added to the Geneva mine screening and crushing plant to make the crude ore amenable to crushing to ⅜-inch size. County iron ore shipments were substantially less than in 1960.

Nearly 700,000 tons of sand and gravel was mined; most of it was produced under contract for the State highway department for road construction. Some sand for ice control was reported, as well as a small quantity of sand and gravel for building construction.

Gratiot.—Michigan Chemical Co. produced bromine, calcium chloride, magnesium compounds, and salt from natural well brines at its plant in St. Louis. Material for fill, building, and road construction was obtained from six sand and gravel pits.

Petroleum was produced from the Sumner field, and natural gas from the North Star field. Crude oil was refined at two plants of Leonard Refineries, Inc., at Alma. Byproduct sulfur was recovered from crude petroleum at the refinery.

Hillsdale.—Petroleum output was the largest of any county in the State. Nearly 4.2 million barrels of petroleum and 3 billion cubic feet of natural gas were produced from fields in the Albion-Pulaski-Scipio trend.

Marl was obtained from pits near Coldwater and Hanover. At Hillsdale, sandstone for flagging was quarried from the Canary Hill quarry. Over 750,000 tons of sand and gravel was produced, at several sites.

Houghton.—Copper was produced by Calumet & Hecla, Inc., Calumet; Copper Range Co., Painesdale; and Quincy Mining Co., Hancock.

Calumet & Hecla, Inc., operated the Ahmeek No. 2, Allouez No. 3, Centennial No. 2, Centennial No. 3, Peninsula, Seneca No. 2, and Osceola No. 13 mines. Shipments also were made from two tailing dumps. Further exploration was carried on in the Calumet Conglomerate lode through the Centennial No. 3 shaft. At the Osceola No. 13 shaft, geological and geophysical methods were used to locate high-grade footwall ore pockets. Operations were terminated at the Ahmeek No. 2 shaft on December 1 because of depletion of ore.

Copper Range Co. operated the Champion mine, except for the periods of February 1 to May 15 and July 11 to September 5. Ore from the Champion mine and tailing from the Redridge sands were treated at the Freda mill. Concentrates were processed at the White Pine Co. smelter in Ontonogan County.

Quincy Mining Co. operated its tailing reclamation plant throughout the year, and the concentrate was smelted at the company Hancock smelter.

Limestone Mountain Co. quarried and crushed limestone for use as roadstone and concrete aggregate. The Houghton County Road Commission quarried basalt for road use. Paving materials were obtained from seven sand and gravel operations.

Huron.—The Michigan Sugar Co. plant at Sebawaing produced hydrated lime for its own use. A coke-fired shaft kiln was used. Wallace Stone Co. quarried limestone at Bayport. Rough construction stone, roadstone, railroad ballast, and agricultural limestone were produced. Materials for fill, building, and road use were reported by four sand and gravel producers.

A small quantity of petroleum was produced from the Dwight and Grant fields.

Ingham.—Moss peat was produced in the Lansing area for horticultural use. Over 1 million tons of sand and gravel was produced at 16 operations. Quicklime was produced and used by the Lansing Board of Water and Light. The lime was recovered from calcium carbonate precipitated in the water purification process.

Ionia.—Over 500,000 tons of sand and gravel was produced, mostly for road construction. Most of the material was produced by portable plants operating throughout the county.

The Bloomer field yielded a small quantity of petroleum.

Iosco.—Gypsum was mined from quarries near Tawas City by National Gypsum Co. and near Alabaster by United States Gypsum Co. National Gypsum Co. operated a processing plant at National City and port facilities at Tawas Bay for shipment of crude material to processing plants in Illinois and Ohio. Gravel for road construction was produced for the State highway department.

Iron.—Tonnage of iron ore shipped from the county was 9 percent below that of 1960. The Hanna Mining Co. operated the Cannon, Hiawatha, Homer, and Wauseca mines. The Cannon mine also shipped approximately 15,000 long tons of manganiferous iron ore. Inland Steel Co. operated the Bristol and Sherwood mines. Production at the Buck Unit of Pickands Mather & Co. ceased in March, and the mine was closed on May 16. No iron ore shipments were made from the property during the year. Only maintenance work was performed at the Tobin Group of Republic Steel Corp. during 1961.

Road gravel was produced for use by the county and State highway departments.

Isabella.—Petroleum production declined from 761,000 barrels in 1960 to 621,000 barrels, while natural gas output decreased from 302 million cubic feet to 269 million cubic feet. The largest oil production came from the Coldwater and Mount Pleasant fields, while most of the gas came from the Coldwater field. Crude oil was refined at the Mount Pleasant refinery of Leonard Refineries, Inc.

Marl was obtained from a pit near Weidman. County pits yielded over 500,000 tons of sand and gravel, much of it produced with portable plants.

Jackson.—Over 3.1 million barrels of petroleum and nearly 2.4 billion cubic feet of natural gas were produced from the Jackson County portion of the Albion-Pulaski-Scipio trend. Although the increase in oil production was not as spectacular as in previous years, the output of oil well gas was four times as great as in 1960.

Sandstone was quarried in the Napoleon area at three sites. It was used for riprap, rubble, and flagging; it was milled for building use and crushed for filler and foundry use. Limestone was quarried and crushed near Parma for concrete aggregate, roadstone, and agricultural limestone. Nearly 800,000 tons of sand and gravel was produced at pits throughout the county. Marl was obtained from a pit near Horton and sold for soil conditioning.

Kalamazoo.—Reed-sedge and moss peat was dug from bogs in the Kalamazoo area and near Scotts. It was sold in bulk to florists and gardeners. Pits near Climax, Mattawan, Schoolcraft, and Vicksburg yielded marl for agricultural use. Nearly 800,000 tons of sand and gravel was produced at several sites in the county by 11 operators.

The Alamo field yielded a small quantity of petroleum. Lakeside Refining Co. at Kalamazoo refined crude oil.

Kalkaska.—Petroleum and natural gas were obtained from the portion of the Beaver Creek field in Kalkaska County.

Sand for ice control and gravel for road use were produced for the county and State highway departments.

Kent.—Underground gypsum mines were operated near Grand Rapids by Bestwall Gypsum Co. and Grand Rapids Plaster Co. The crude material was processed at company-owned plants, where wallboard, lath, sheathing, and plaster were produced. Sand and gravel valued at over $2.2 million was produced in the county. Moss and reed-sedge peat was obtained from bogs in the Grand Rapids area.

Oil and gas produced from the Kent County portion of the Walker field totaled 146,000 barrels of petroleum and 22 million cubic feet of natural gas.

Lake.—About 7,000 barrels of petroleum was produced from the Chase, Reed City, and Sauble fields. Sand for ice control and gravel for road use were produced for the county and State highway departments.

Lapeer.—Calcium chloride and calcium magnesium chloride were extracted from natural well brines at the Mayville plant of Wilkinson Chemical Corp. A large quantity of peat was obtained from bogs near Almont and Imlay City. Sand and gravel production was reported by five operators.

Lenawee.—General Portland Cement Co. produced portland and masonry cements at Cement City. A pit near Rollin provided clay for use at the plant. Draintile was manufactured by Comfort Brick & Tile Co. from clay mined near Tecumseh. Humus peat was produced in the same area. Over 700,000 tons of sand and gravel was produced at 11 operations. A small quantity of petroleum was produced from the Mason Creek and Medina fields, which were discovered in 1961.

Mackinac.—Limestone was quarried near Cedarville by the Michigan Limestone Division of United States Steel Corp. and at Manistique by Inland Lime & Stone Co., a division of Inland Steel Co. In addition to the quarries, both operations included extensive processing plants and port facilities at Cedarville and Port Inland, respectively. Most of the output was shipped by boat to industrial consumers. Production was below the 1960 level because of decreased demand for blast furnace flux. In addition to the use of limestone for flux, limestone was shipped to cement plants, lime plants, sugar mills, and paper mills. The limestone was also used for rubble, riprap, concrete aggregate, roadstone, agricultural limestone, railroad ballast, and several other purposes. Sand and gravel was produced at six sites.

Macomb.—Production of over 1 million tons of sand and gravel was reported from 17 operations. Principal uses were for fill and building and paving purposes. Over 400 million cubic feet of natural gas, mostly from the Lenox field, was produced. A small quantity of oil was produced from the Lenox and Mount Clemens fields.

Manistee.—Chemicals derived from natural salines were the principal products of the county. In the Manistee area, natural well brines from the Filer formation were processed at plants operated by Great Lakes Chemical Co., Michigan Chemical Co., Morton Chemical Co., and Standard Lime & Cement Co., a division of Martin Marietta Corp. Bromine, calcium chloride, and magnesium compounds were recovered. Salt was recovered from artificial brines by Manistee Salt Works and Morton Salt Co. The Packaging Corp. of America recovered quicklime for its own use from calcium carbonate sludge at its Filer City kraft pulp mill. An oil-fired rotary kiln was used. Industrial sand (molding, grinding, and polishing) and sand and gravel for fill and building and paving purposes were produced at several sites in the country.

Marquette.—Iron ore was produced by Cleveland-Cliffs Iron Co. at eight mines; by Inland Steel Co. at two mines; and by Jones & Laughlin Steel Corporation and North Range Mining Co. at one mine each. The Volunteer-Maitland mine of Pickands Mather Co. did not operate in 1961. On February 23, the Morris mine of Inland Steel Co. was closed; stockpile shipments were completed in June. The Cleveland-Cliffs Iron Co. Mather Mine "A" shaft hoisting and surface plants were idle during the year. Ore mined from the "A" shaft was transported to the "B" shaft and handled through the "B" shaft hoisting and surface facilities.

Expansion of facilities for mining and processing low-grade iron ore continued. The Republic mill of Cleveland-Cliffs Iron Co. was being enlarged. On completion, scheduled for 1962, the plant will have an annual capacity of 2.4 million tons of high-grade iron ore concentrate, and the agglomerating plant will be capable of pelletizing 1.6 million tons. It was planned to pelletize the excess concentrate at the Eagle Mills agglomerating plant of Cleveland-Cliffs Iron Co.

The Empire Mining Co. announced plans for developing an open-pit mine, and installing a magnetic concentrator, and a 1-million-ton-per-year pelletizing plant near Negaunee. This facility was to be operated by Cleveland-Cliffs Iron Co., and completion was scheduled for 1963. This was the first low-grade magnetic iron ore deposit to be developed in northern Michigan. Since the iron mineral in the jasper ore is magnetite, it will be concentrated by magnetic separators, rather than by flotation. The crude ore, containing about 30 percent iron, will be processed to produce a concentrate containing about 65 percent iron, which will be pelletized for blast furnace feed.

Output of sand and gravel valued at over $500,000 was reported by nine producers.

Mason.—The Dow Chemical Co. operated plants in the Ludington area and produced bromine, calcium chloride, calcium magnesium chloride, magnesium compounds, and lime. Harbison-Walker Refractories Co. produced refractory magnesia from purchased magnesium hydroxide. Industrial sand (molding, grinding, polishing, and engine sand) was mined from a pit near Ludington. Paving gravel was produced for the county and State highway departments.

Petroleum production decreased to 91,000 barrels from 142,000 barrels in 1960. Output was reported from the Eden, Oxbow, Pentwater, Riverton, and Scottsville fields. A small quantity of oil well gas came from the Eden field.

Mecosta.—Marl for soil conditioning was obtained from pits near Blanchard and Mecosta. Sand and gravel pits were operated at four sites. About 38,000 barrels of petroleum and 166 million cubic feet of natural gas were recovered from six fields.

Menominee.—Limestone Products Division of Northwestern-Hanna Fuel Co. produced quicklime and hydrated lime for industrial and chemical consumption. Nearly 800,000 tons of sand and gravel was produced. Most of it was used by the county and State highway departments.

Midland.—Natural well brines of the Sylvania formation were processed by The Dow Chemical Co. for the recovery of bromine, calcium chloride, calcium magnesium chloride, iodine, magnesium compounds, and potassium. Salt was recovered from artificial brines. Kaiser Aluminum & Chemical Co. produced refractory magnesia from purchased magnesium hydroxide for use at its refractories plant in Ohio. Over 321,000 barrels of petroleum and 27 million cubic feet of natural gas were recovered. Largest production came from the Porter field.

Missaukee.—Petroleum production declined to 786,000 barrels from 863,000 in 1960. Natural gas output nearly doubled, rising to 618 million cubic feet from 322 million cubic feet in 1960. The largest quantity of petroleum came from the McBain field, and the East Norwich field produced the most gas.

Gravel was produced at several sites for road use.

Monroe.—Portland and masonry cements were manufactured by Dundee Cement Co. at Dundee. Clay and limestone, for use at the plant, were produced from company-owned quarries and pits in the immediate area. Limestone was quarried and crushed at Monroe by France Stone Co., at Maybe by Maybe Stone Co., at Ottawa Lake by Michigan Stone Co., and by the county highway department. The material was sold or used for concrete aggregate, roadstone, railroad ballast, agricultural limestone, riprap, and flux. F. W. Ritter Sons Co. manufactured pottery from miscellaneous clay mined near South Rockwood. Peat was dug from bogs near Ida and Petersburgh and sold for soil conditioning. A small quantity of petroleum was recovered from the Deerfield field.

Montcalm.—Petroleum output decreased to 528,000 barrels from 605,000 in 1960, while natural gas production remained about the same (384 million cubic feet). The Edmore and Reynolds fields reported the largest production. Crude oil was refined at Crystal Refining Co. in Carson City.

Bogs near Lakeview yielded reed-sedge and moss peat. Sand and gravel was produced principally for use of the county and State highway departments.

Muskegon.—Hooker Electrochemical Co. produced salt from artificial brines at Montague. Molding and engine sand was produced at Muskegon, while gravel for road use was mined at several sites. Nearly 19,000 barrels of petroleum and 11 million cubic feet of gas were recovered. Crude oil was refined at Muskegon by Naph-Sol Refining Co. and Ohio Oil Co.

Newaygo.—The Ensley gasfield yielded 229 million cubic feet of natural gas. Petroleum production dropped to 52,000 barrels from 72,000 in 1960. Marl was obtained from pits near Grant. Sand and gravel was produced at four sites.

Oakland.—Sand and gravel valued at nearly $6 million, $800,000 more than in 1960, was produced. The bulk of the tonnage was used for road construction, but substantial quantities were used for fill and building construction. Oakland County remained the fourth largest producer of peat.

Small quantities of petroleum and natural gas were recovered from the Oakland County portion of the Northville field.

Oceana.—Oil and gas were recovered from eight fields. Production of petroleum increased 18,000 barrels to 269,000, while the natural gas output declined from 47 million cubic feet in 1960 to 11 million. Sand and gravel was produced at four sites.

Ogemaw.—Petroleum from the Rose City and West Branch fields and natural gas from the Rose City field accounted for nearly all the mineral production. Petroleum output declined from 491,000 barrels in 1960 to 441,000 barrels. Natural gas production was 796 million cubic feet, about the same as in 1960. Crude oil was refined by West Branch Refineries, Inc. Road gravel and fill sand was produced by two operators.

Ontonagon.—Copper was mined, milled, and smelted by White Pine Copper Co. (a wholly owned subsidiary of Copper Range Co.). In November the development shaft to the new Southwest ore body was completed. The company planned to have this mine in production in 1964. The State highway department contracted for paving gravel.

Osceola.—Over 481,000 barrels of petroleum and 368 million cubic feet of natural gas were produced, principally from the Reed City field. Crude oil was refined at Reed City by Osceola Refining Co. Marl was produced near Marion and Tustin. Building and paving sand and gravel was obtained at two sites.

Ottawa.—The county was a major producer of sand and gravel, with output of nearly 1.5 million tons. Although most of the material was used in road construction, a considerable quantity of industrial sand was used. Pits near Allendale and Jenison yielded a small quantity of marl. Nearly 200,000 barrels of petroleum was recovered, principally from the Walker field.

Presque Isle.—Large limestone quarries, processing plants, and ports were operated by Michigan Limestone Division of United States Steel Corp. at Rogers City and by Chemstone Co. (operators for Presque Isle Corp.) at Presque Isle. Most of the shipments were by water to consumers in the Great Lakes area. The stone was used for a variety of industrial purposes (in steel mills, cement, chemical, and lime plants, and sugar and paper mills) as well as for concrete aggregate, roadstone, and agricultural use.

Onaway Stone Co. quarried limestone near Onaway. Rough construction stone and rubble, sawed and cut building stone, and flagging were produced. Sand and gravel was mined and processed at Millersburg by Straits Aggregate & Equipment Corp. The State highway department contracted for road gravel from two operators.

Roscommon.—Nearly 1.3 billion cubic feet of natural gas and 244,000 barrels of petroleum were produced. Most of the production came from the Headquarters and Saint Helen's fields.

About 800,000 tons of sand and gravel was produced by six operators. The material was principally used for road construction.

Saginaw.—Miscellaneous clay was mined near Saginaw by Aetna Portland Cement Co. for its own use and by Minco Products Corp. for use in refractories and filler. Michigan Sugar Co. produced hydrated lime for its own use at the Carrollton plant. The State highway department contracted for paving sand and gravel. Petroleum output of 54,000 barrels was about the same as in 1960. Nearly all the production came from the Birch Run and Saginaw fields. Crude oil was refined at the Bay Refining Corp. plant in Saginaw.

St. Clair.—Peerless Cement Co., Division of American Cement Corp., manufactured portland cement at Port Huron. Clay was mined locally for use at the plant. Salt was recovered from artificial brines at St. Clair by Diamond Crystal Salt Co. and at Marysville by Morton Salt Co. Michigan Peat Co. produced reed-sedge peat from bogs near Capac. The material was sold in packaged and bulk form to the horticultural trade. Sand and gravel production was reported by seven operators.

Output of petroleum and natural gas was double that of 1960. The most intensive drilling activity in the State was in St. Clair County. Sixty-eight oil wells and 30 gas wells were completed during the year, as well as 92 dry holes. Exploratory well drilling resulted in seven new fields and two extensions.

St. Joseph.—Marl was obtained from pits near Colon and Three Rivers. Peat was recovered from a bog near Three Rivers. Aggregate Processors, Inc., produced sand and gravel at White Pigeon for fill, road construction, and building purposes.

Sanilac.—Hydrated lime was produced at the Croswell plant of Michigan Sugar Co. for company use. Peat was obtained from bogs near Minden City and Sandusky. Paving gravel was produced with portable plants at several sites.

Shiawassee.—Michigan Vitrified Tile Co. mined miscellaneous clay near Corunna for use in manufacturing heavy clay products. Nearly 500,000 tons of sand and gravel was produced at eight operations.

Tuscola.—The Caro plant of Michigan Sugar Co. produced hydrated lime for use in sugar refining. Moss peat was obtained from a bog near Caro. Output of 1.7 million tons of sand and gravel was reported by 17 producers. The material included molding sand and sand and gravel for fill, building, and paving. Petroleum production totaled 99,000 barrels, compared with 114,000 in 1960.

Van Buren.—Petroleum output of 21,000 barrels was about the same as in 1960. Production came from four fields. The Breedsville field was abandoned during the year.

Industrial sand was produced at pits near Covert and South Haven, while materials for fill, building, and paving were obtained from four sand and gravel deposits. A pit near Paw Paw yielded marl for soil conditioning.

Washtenaw.—Sand and gravel output totaled 4.8 million tons and was valued at $3.5 million, over twice the amount reported in 1960. Increased production was due to road construction in the county. Reed-sedge peat was obtained from a bog near Ypsilanti.

Over 45,000 barrels of petroleum and nearly 700 million cubic feet of natural gas were recovered from the Northville field.

Wayne.—The county maintained its second-place rank in value of mineral commodities produced, but total value was $5 million less than in 1960. A decline was noted in the output of all mineral commodities produced except natural gas, which was double the 1960 figure, and petroleum, which was about the same as in 1960.

Peerless Cement Co., Division of American Cement Corp., manufactured portland and masonry cements at two plants in Detroit. The company obtained clay for cement from the Ford clay pit near Allen Park. Wyandotte Chemical Co. produced portland cement at Wyandotte. Flat Rock Clay Products Co. manufactured draintile from clay mined in Brownstown township. Lightweight Aggregates Corp. produced lightweight aggregate at Livonia from clay mined at the plant site. Quicklime was produced in Detroit by Solvay Process Division, Allied Chemical Corp. and at Wyandotte by Wyandotte Chemicals Corp. A large part of the output was used by the producers in manufacturing chemicals. In Detroit, International Salt Co. produced salt from its underground mine. At Wyandotte, Pennsalt Chemical Corp. and Wyandotte Chemical Co. recovered salt from artificial brines. Limestone was quarried and crushed near Flat Rock and Trenton for concrete aggregate and roadstone. Nearly 2 million tons of sand and gravel was obtained from pits throughout the county. Considerable quantities of industrial sand and fill material, as well as building and paving sand and gravel, were mined.

Natural gas production exceeded 1 billion cubic feet. Petroleum output was about 14,000 barrels. Byproduct sulfur was recovered from crude petroleum by Aurora Gasoline Co., Division of Ohio Oil Co., in Detroit. Crude oil refineries were operated by Petroleum Specialties, Inc., at Flat Rock; by Socony-Mobil Oil Co., Inc., at Trenton; by Wyandotte Chemical Corp. at Wyandotte; and by Aurora Gasoline Co. at Detroit.

The Mineral Industry of Minnesota

By Matthew G. Sikich[1]

◆

MINERAL output in Minnesota in 1961 was valued at $450.5 million, a 13-percent decrease from 1960. Principal reason for the decline was the 18-percent decrease in iron-ore shipments. Lower total value of production compared with 1960 also was recorded for manganiferous ore, fire clay, grinding pebbles, sand and gravel, and stone. However, the quantities of sand and gravel and fire clay produced increased. Gains in both quantity and value of output were reported for miscellaneous clay and shale, portland and masonry cements, lime, and peat. Record quantity highs were established for clays, and sand and gravel. Iron-bearing ores (including manganiferous ore) continued to furnish the bulk of the State total mineral value, comprising 91 percent of the 1961 total.

Ceremonies formally opening the new Minneapolis Research Center of the Federal Bureau of Mines were held in June. Mining and metallurgical research and industry fact-finding activities were conducted at the center. In November three carlots of low-grade nonmagnetic ore, one from the Mesabi Range and two from Cuyuna Range stock-piles were shipped to the Krupp Steel Works in Essen, West Germany, for tests of the Krupp-Renn process of direct reduction. The project was part of a research program financed principally by the Minnesota Iron Range Resources and Rehabilitation Commission and the Federal Area Redevolpment Administration.

Employment and Injuries.—Approximately 29.6 million man-hours were worked in Minnesota mineral industries in 1961, excluding office-workers. This represented a 20-percent decrease from the 37.1 million man-hours recorded for 1960. The drop was attributed primarily to the substantial decrease in State shipments of iron ore.

Five fatalities, four in the iron-mining industry and one at a sand and gravel plant, occurred in 1961, compared with four in 1960. Total number of nonfatal disabling injuries decreased from 406 (final figure) to 243.

The Pioneer mine of Oliver Iron Mining Division of United States Steel Corp. won the highest award, the Sentinels of Safety Trophy, in the metal-mine group of the 1961 National Safety Competition. The mine, located at Ely, worked 687,961 man-hours without a disabling injury. This was the second victory for the Pioneer mine, having won also in 1958. A number of other mines and plants in the State experienced injury-free records in 1961 and received Certificates of Achievement in Safety from the Federal Bureau of Mines.

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All employment and injury data were collected from operating companies on a voluntary basis. Data represent virtually complete coverage of the State mineral industry.

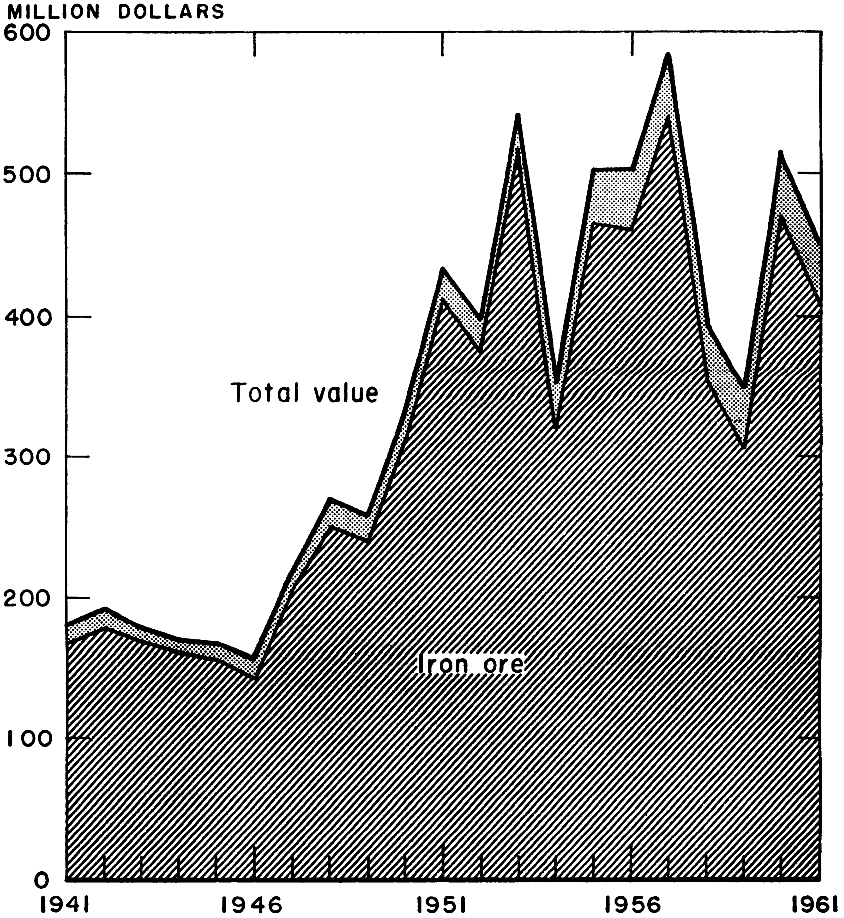

FIGURE 1.—Value of iron-ore shipments and total value of all minerals produced in Minnesota, 1941–61.

TABLE 1.—Mineral production in Minnesota [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] ....thousand short tons..	125	$163	176	$241
Iron ore (usable)..thousand long tons, gross weight....	54,723	470,874	44,699	407,152
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight..	441,028	(3)	181,835	(3)
Peat........short tons..	1,465	72	11,091	181
Sand and gravel........thousand short tons..	30,302	24,611	30,690	24,143
Stone........do....	4,234	10,034	3,957	9,975
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay, gem stones, lime, and values indicated by footnote 3........	....	9,767	....	9,223
Total Minnesota [4]........	....	515,255	....	450,509

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay included with "Value of items that cannot be disclosed."

[3] Figure withheld to avoid disclosing individual company confidential data.

[4] Total adjusted to eliminate duplicating value of stone.

REVIEW BY MINERAL COMMODITIES

METALS

Iron Ore.—Shipments of usable iron ore (excluding ore containing 5 percent or more manganese, natural) were 44.7 million long tons, 18 percent lower than in 1960. A generally low demand for iron ore and the desire for higher quality ores by the Nation's steel industry contributed to the marked decline in total shipments. However, the demand by consuming blast furnaces for a high-quality feed resulted in an increase in shipments of taconite concentrate to nearly 14.4 million long tons, compared with 11.4 million tons in 1960. Minnesota ranked first in iron-ore production, supplying 62 percent of the total usable iron ore shipped from mines in the United States in 1961.

TABLE 2.—Dates of first and final cargoes of iron ore at United States upper Great Lakes ports

Port and dock	1960		1961	
	First	Final	First	Final
Ashland, Wis.:				
C&NW........	Apr. 17	Nov. 6	May 11	Nov. 20
Soo Line........	Apr. 17	Nov. 6	May 11	Nov. 20
Duluth, Minn.: DM&IR........	Apr. 19	Nov. 5	May 16	Nov. 1
Escanaba, Mich.: C&NW........	Mar. 28	Nov. 17	Apr. 25	Nov. 25
Marquette, Mich.:				
DSS&A........	Apr. 29	Nov. 7	May 20	Nov. 15
LS&I........	Apr. 16	Nov. 26	Apr. 24	Dec. 4
Silver Bay, Minn.: Reserve........	Apr. 11	Nov. 20	Apr. 15	Dec. 3
Superior, Wis.:				
GN........	Apr. 12	Nov. 18	Apr. 24	Dec. 3
NP-Soo Line........	Apr. 20	Nov. 5	May 4	Nov. 7
Taconite Harbor: Erie........	Apr. 14	Nov. 20	May 9	Nov. 30
Two Harbors, Minn.: DM&IR........	Apr. 5	Nov. 17	May 1	Nov. 24

Source: Skillings' Mining Review.

TABLE 3.—Usable iron ore[1] produced (direct-shipping and all forms of concentrate), by ranges

(Thousand long tons)

Year	Cuyuna	Mesabi	Vermilion	Spring Valley district	Total
1952–56 (average)	2,356	60,925	1,466	294	65,041
1957	2,018	64,537	1,349	382	68,286
1958	1,119	39,833	1,027	241	42,221
1959	745	33,747	809	576	35,877
1960	1,166	54,442	1,361	473	57,442
1961	1,095	41,199	930	491	43,714

[1] Exclusive of iron ore containing 5 percent or more manganese.

TABLE 4.—Crude iron ore[1] data, in 1961, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To beneficiation plants	
County:						
Crow Wing	32	274	1,161	641	784	42
Fillmore	-----	-----	897	-----	897	-----
Itasca	35	-----	25,214	271	24,958	19
St. Louis	1,088	1,302	63,356	11,723	53,187	836
Total[2]	1,155	1,576	90,627	12,635	79,825	898
Range:						
Cuyuna	32	274	1,161	641	784	42
Mesabi	927	307	88,570	11,675	77,351	778
Vermilion	196	995	-----	319	794	78
Spring Valley district	-----	-----	897	-----	897	-----
Total[2]	1,155	1,576	90,627	12,635	79,825	898

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Data do not add to totals shown because of rounding.

TABLE 5.—Usable iron ore[1] data, in 1961, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production	Iron content of production	Shipments	Stocks Dec. 31
County:					
Crow Wing	[2] 177	1,095	542	1,157	115
Fillmore	12	491	231	502	-----
Itasca	[2] 840	10,035	5,503	9,918	956
St. Louis	[2] 4.017	32,094	17,939	33,122	2,990
Total[3]	[2] 5,046	43,714	24,215	44,699	4.061
Range:					
Cuyuna	[2] 177	1,095	542	1,157	115
Mesabi	[2] 4,719	41,199	22,881	42,175	3,743
Vermilion	[2] 138	930	561	865	203
Spring Valley district	12	491	231	502	-----
Total[3]	[2] 5,046	43,714	24,215	44,699	4,061

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Revised figure.
[3] Data do not add to totals shown due to rounding.

TABLE 6.—Iron ore[1] shipped from Minnesota mines

(Thousand long tons)

Year	Crude ore to concentrators	Beneficiated			Total usable ore[2]	Proportion of beneficiated to total usable ore (percent)
		Agglomerates	Other	Total		
1952–56 (average)	47,073	2,060	21,444	23,504	65,022	36.15
1957	68,439	6,836	23,539	30,375	67,656	44.90
1958	55,224	8,829	14,460	23,289	42,502	54.79
1959	48,024	8,401	11,513	19,914	36,109	55.15
1960	88,060	11,489	21,693	33,181	54,723	60.63
1961	79,825	14,366	17,698	32,064	44,699	71.73

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Direct-shipping and beneficiated ore.

Iron ore was shipped by 20 companies from mines in Crow Wing, Fillmore, Itasca, and St. Louis Counties. Shipments from the Mesabi Range (in Itasca and St. Louis Counties) constituted 94 percent of the State shipments of usable ore. Mines in the Cuyuna Range in Crow Wing County furnished 3 percent; the Vermilion Range in St. Louis County, 2 percent; and the Spring Valley District in Fillmore County, the remainder. Over 98 percent of the 92.2 million tons of crude iron ore mined in 1961 was from open-pit mines; the balance was supplied from several underground mines. Approximately 87 percent of the crude ore was concentrated. Of the total usable ore shipped, concentrates comprised 72 percent and direct-shipping grades furnished the remainder. (Crushed, screened, and sized ores not further treated are considered as direct-shipping material.) Average iron content of usable ore produced was 55.4 percent, natural, compared with 54.2 percent in 1960.

Shipments of taconite concentrate increased about 3 million tons over the previous year and comprised 32 percent of the total iron-ore output. Erie Mining Co. (operating agent, Pickands Mather & Co.) and Reserve Mining Co. operated their large-scale taconite-processing plants at Hoyt Lakes and Silver Bay, respectively, and broke all previous shipment records. The Erie Mining Co. plant was shut down for a short period in July while maintenance work was performed. Reserve Mining Co. operated full capacity throughout most of the year, despite a major construction program to expand its annual capacity to about 9 million tons of pellets. A second primary crushing plant at the mine site near Babbitt, and 45 miles of new track paralleling the original rail line connecting Babbitt and Silver Bay were completed in 1961. Enlargement of plant facilities at Silver Bay was well underway by the end of the year. The $120 million expansion program was expected to be completed early in 1963. In November Reserve Mining Co. began using natural gas in the company pelletizing furnaces, the first use of natural gas in processing iron ore in Minnesota. Oliver Iron Mining Division of United States Steel Corp. also produced taconite concentrate, from the company's taconite mine and concentrator near Mountain Iron, and agglomerating plant at Virginia.

Efforts continued to determine the feasibility of commercially utilizing the nonmagnetic iron ores of the Minnesota iron ranges. Oliver Iron Mining Division and The Hanna Mining Co. (formerly The M. A. Hanna Co.) conducted experimental research at their new semitaconite pilot plants near Coleraine and Cooley, respectively. Lurgi kilns were used in both plants to convert the nonmagnetic semitaconite to magnetic form for subsequent processing by magnetic separation. In November three carloads of low-grade nonmagnetic ore, one from the Mesabi Range and two from Cuyuna Range stockpiles, were shipped to the Krupp Steel Works in Essen, West Germany, for tests of the Krupp-Renn process of direct reduction. The project was part of a research program financed principally by the Minnesota Iron Range Resources and Rehabilitation Commission and the Federal Area Redevelopment Administration. Zontelli Brothers Division of Pittsburgh Pacific Co. was directing the project in cooperation with the Krupp Steel Works and Southwestern Engineering Co. of Los Angeles, Calif., which held the American license on the Krupp-Renn process.

Pickands Mather & Co. resumed operations at the Rabbit Lake mine in the Cuyuna Range and the West Hill mine in the Mesabi Range. Early in the year the company closed the Mahnomen and Tioga No. 2 mines near Crosby and Grand Rapids, respectively. Equipment at the Tioga No. 2 was transferred to other mines. The Mahnomen mine was reopened later in the year by The Hanna Mining Co. The latter company ceased operations at the Enterprise mine near Virginia, and the South Longyear and Weggum mines near Hibbing after reserves at these mines were depleted. Hanna also closed the Robert mine and canceled leases on the Alstead and Musser mines in the Cuyuna Range. Cleveland-Cliffs Iron Co. installed a new cyclone unit at the Canisteo mine near Coleraine and a reject conveyor and stacker at the Hill-Trumbull mine near Marble. Jones & Laughlin Steel Corp. completed construction of a new beneficiation plant at the Hill Annex mine near Calumet. The plant had an annual capacity of 500,000 tons of concentrate and was to process previously unusable semitaconite iron-bearing material. At the end of the year, Jones & Laughlin was enlarging the concentrating plant at the Lind-Greenway mine near Grand Rapids by adding heavy density and jigging sections. Oliver Iron Mining Division began operating its new Sherman concentrator, treating ores from the Monroe and Sherman groups of mines near Chisholm. The company also constructed a new concentrator at the Pioneer underground mine near Ely. The plant was built within the mine headframe, which will permit year-round operation. The Zenith underground mine of Zenith Mining Co., near Ely, closed for 3 months early in 1961 because of a slump in demand for ore, was reopened in June, when market conditions improved. Snyder Mining Co. ceased mining at the Godfrey underground mine in August but continued to ship ore from stockpile. Late in the year Pioneer Mining Co. sold its assets to Pittsburgh Pacific Co. and was in the process of liquidation. The company formerly operated the Mary Ellen mine and heavy-medium plant, near Biwabik.

Nearly all the iron ore shipped from Minnesota was for use in manufacturing pig iron and steel. Small quantities were sold for heavy-medium purposes and for manufacturing paint and cement.

Approximately 98 percent of the ore shipped was hauled by rail from the mines to Lake Superior harbors, transported by vessel to Lower Lake ports, and thence to consuming districts. The remainder was shipped all-rail to consumers. Some Minnesota ore was consumed at the Duluth plant of the American Steel & Wire Division of United States Steel Corp. The Duluth blast furnace of Interlake Iron Corp. was inactive the entire year.

The 1961 navigation season for ports shipping Minnesota iron ores opened April 15 at Silver Bay. Final cargoes of the season left Silver Bay and Superior on December 3.

Lake Erie base prices for iron ore were unchanged from 1960. Average weighted mine value for Minnesota iron ore was $9.11 per long ton, compared with $8.60 in 1960. The increase was attributable primarily to the greater percentage of taconite concentrate comprising the total shipments.

The Federal Bureau of Mines continued research on the beneficiation of iron ores from taconites and semitaconites at its Minneapolis Research Center. Pilot plant studies were made of the anionic flotation of silica from various Mesabi Range samples. Research begun in 1960 on the preparation of super blast-furnace feed [2] was continued, and metallized pellets were successfully prepared using a 1-foot by 15-foot rotary kiln. A preliminary report of a long-range program to sample, classify, and evaluate important occurrences of nonmagnetic taconite on the Mesabi Range [3] and the results of smelting taconite in the experimental blast furnace [4] were published.

Manganiferous Ore.—Shipments of manganiferous ore (containing 5 to 35 percent manganese, natural) decreased 59 percent from 1960 and were the lowest on record since 1932. Low demand by the steel industry and competition from foreign ores were chiefly responsible for the drop in output. Total shipments consisted of 72,000 short tons of direct-shipping grade and 110,000 tons of concentrate. Output was divided nearly equally between manganiferous iron ore (containing 5 to 10 percent manganese, natural) and ferruginous manganese ore (containing 10 to 35 percent manganese, natural). All shipments of ferruginous manganese ore were from stocks, as were 6,000 tons of manganiferous iron ore. Approximately 19 percent of the 89,000 tons of crude ore mined were beneficiated. Average natural iron and manganese contents of the total shipments in 1961 were 33.83 and 10.66 percent, respectively.

Shipments of manganiferous ore were from eight mines, all in Crow Wing County in the Cuyuna Range. Producing companies were Zontelli Brothers Division of Pittsburgh Pacific Co. and The Hanna Mining Co. Most of the output was used in making pig iron.

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[2] Journal of Metals. Pre-Reduced Iron-Ore Pellets, Their Experimental Preparation. V. 13, No. 4, April 1961, pp. 314.

[3] Marovelli, R. L., D. W. Frommer, F. W. Wessel, L. F. Heising, P. A. Wasson, and R. E. Lubker. Lake Superior Iron Resources: Preliminary Sampling and Metallurgical Evaluation of Mesabi Range Nonmagnetic Taconites. BuMines Rept. of Inv. 5670, 1961, 35 pp.

[4] Royer, M. B., N. B. Melcher, and W. O. Philbrook. Smelting Taconite in the Bureau of Mines Experimental Blast Furnace. BuMines Rept. of Inv. 5724, 1961, 15 pp.

Some was sold to Manganese Chemicals Corp. which produced manganese products at its chemical plant at Riverton.

Total value of manganiferous ore shipped from the State decreased 60 percent from 1960 because of the marked decline in output. Iron ores containing over 5 percent manganese, natural, had generally been priced as Old Range non-Bessemer on the combined natural iron and manganese content, plus a premium for the natural manganese exceeding 5 percent.

TABLE 7.—Shipments of usable[1] manganiferous iron ore and ferruginous manganese ore from mines in the Cuyuna Range

(Long tons)

Year	Manganiferous iron ore (5 to 10 percent Mn, natural)			Ferruginous manganese ore (10 to 35 percent Mn, natural)			Total shipments
	Shipments	Contents (natural)		Shipments	Contents (natural)		
		Fe, percent	Mn, percent		Fe, percent	Mn, percent	
1952–56 (average)	632,514	38.76	5.88	80,280	33.11	12.00	712,794
1957	438,820	39.58	6.28	179,301	34.20	12.02	618,121
1958	285,995	41.47	6.22	44,901	34.51	13.14	330,896
1959	273,541	39.35	6.42	109,586	34.34	11.76	383,127
1960	345,426	38.97	7.15	48,349	34.37	12.74	393.775
1961	80.603	32.05	9.01	81,750	35.58	12.29	162,353

[1] Direct-shipping and beneficiated ore.

The Bureau of Mines conducted research at the Minneapolis Research Center on developing methods of utilizing potential manganese resources of the Cuyuna Range. About 50 tons of oxidized ore and concentrate were successfully sulfatized in a vertical shaft furnace. Test work also included roasting, magnetic separation, and flotation. Results of previous work on sulfatizing[5] and flotation[6] were published.

NONMETALS

Abrasive Stones.—Grinding pebbles and tube-mill liners were produced by Jasper Stone Co. from its quartzite deposit in Rock County. Sales of grinding pebbles decreased in quantity and value, whereas output of tube-mill liners increased over 1960. Some broken material was sold for use as riprap.

Cement.—Portland and masonry cements were produced at Duluth by Universal Atlas Cement Division of United States Steel Corp., the sole producer of cement in Minnesota. Total output increased over that of 1960, chiefly because of increased sales for highway construction. Portland cement output was comprised of types I and II (general-use and moderate-heat) and portland-slag cement. Raw materials used in manufacturing portland cement included limestone, gypsum, blast-furnace slag, and small quantities of air-entraining compounds and grinding aids. The plant had one 200-foot and two 150-foot kilns.

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[5] Prasky, C., R. L. Marovelli, and F. E. Joyce, Jr. Evaluating Cuyuna Manganese Resources by Sulfatizing. BuMines Rept. of Inv. 5887, 1961, 27 pp.

[6] Wessel, F. W., P. A. Wasson, and D. W. Frommer. Flotation of Unoxidized Manganiferous Material from the Cuyuna Range, Minnesota. BuMines Rept. of Inv. 5802, 1961, 14 pp.

Clays.—Total production of miscellaneous clay increased 40 percent in quantity and 48 percent in value over 1960. Chief reason for the gain was the substantial increase in output of clay used by North Central Lightweight Aggregate Co., Inc., in manufacturing lightweight aggregate. Tonnage of miscellaneous clay used in manufacturing building brick decreased about 14 percent from 1960. Output of fire clay increased over 1960.

Clay production was reported from operations in Brown, Carlton, Goodhue, Hennepin, Ramsey, and Redwood Counties. Material was used for manufacturing lightweight aggregate, building brick, vitrified sewer pipe, floor and wall tile, and other products.

Dinnerware and art pottery were produced by Red Wing Potteries, Inc., at Red Wing from raw materials produced in other States.

Gem Stones.—A small quantity of semiprecious gem stones, chiefly agates, was collected by hobbyists. Gem materials were found principally along the north shore of Lake Superior, along the Mississippi River, and in gravel pits in the southeastern part of the State. The materials were used primarily for personal collections and handmade jewelry.

Lime.—Total output of quicklime and hydrated lime increased considerably over 1960. Most of the gain was attributable to increased statistical coverage; beginning in 1961 captive lime production is included. Quicklime produced by American Crystal Sugar Co. and used in sugar refining represented a substantial share of the total State lime production. The company produced lime at the following locations: Chaska, Crookston, East Grand Forks, and Moorhead.

Cutler-Magner Co. remained the only commercial producer of lime in the State, operating a plant at Duluth. Total sales of quicklime and hydrated lime increased over 1960. Shipments were chiefly to consumers in Minnesota and neighboring States. Approximately 85 percent of the company's total output was for chemical and industrial purposes, including such uses as paper manufacture, water purification, and metallurgy. Over 12 percent was for construction use, and the remainder for agricultural purposes. A rotary kiln was used for calcining, with bituminous coal as fuel.

Perlite.—Crude perlite mined in New Mexico and Nevada was expanded at plants of Minnesota Perlite Corp. and Western Mineral Products Co. in Minneapolis. Total sales of expanded perlite decreased in quantity but increased in value, compared with 1960. The expanded product was sold for lightweight aggregate in plaster and concrete, soil conditioning, and paint additive.

Sand and Gravel.—A new high was established in production of sand and gravel. Total output was 30.7 million short tons, 1 percent more than in 1960, the previous record year. A slight increase in quantity of material for paving was the chief reason for the gain. Production for building use declined 4 percent from 1960, and output for railroad ballast also declined substantially. Silica sand used in manufacturing glass increased 20 percent over 1960.

Production was reported from every county except Waseca. Major producing areas were in Clay, Dakota, Hennepin, Le Sueur,

TABLE 8.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,685	$3,104	3,596	$3,011
Paving	2,510	1,790	3,021	1,996
Railroad ballast	(1)	(1)	17	11
Fill	463	242	388	221
Grinding and polishing	1	2	1	1
Undistributed [2]	245	800	314	835
Total	6,904	5,938	7,337	6.075
Gravel:				
Building	3,046	4,590	2.805	4,171
Paving	7,996	6,789	8,031	6,747
Railroad ballast	507	480	371	329
Fill	234	135	397	195
Other	99	71	168	127
Total	11,882	12,065	11,772	11,569
Total sand and gravel	18,786	18,003	19.109	17,644
Government-and-contractor operations:				
Sand:				
Paving	2.574	1.352	3,792	1,986
Fill	14	4	101	32
Other	1	(3)		
Total	2,589	1,356	3.893	2,018
Gravel:				
Building			63	35
Paving	8.588	5,135	7,273	4,330
Fill	339	117	346	115
Other			6	1
Total	8,927	5,252	7.688	4,481
Total sand and gravel	11,516	6,608	11,581	6,499
All operations:				
Sand	9,493	7.294	11,230	8,093
Gravel	20,809	17,317	19,460	16,050
Grand total	30,302	24,611	30,690	24,143

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[2] Includes railroad ballast (1960), glass, molding, engine, filler, blast sand, foundry uses, and other sand to avoid disclosing individual company confidential data.
[3] Less than $500.

Polk, Ramsey, St. Louis, and Washington Counties, which furnished 39 percent of the State total tonnage.

Approximately 72 percent of the total quantity produced was for paving; 21 percent, for building use; 4 percent, for fill; and 1 percent, for railroad ballast. Smaller, but important, quantities of special sands were used for manufacturing glass, grinding and polishing, sandblasting, oilfield fracturing, engine use, filler, and foundry applications. Commercial operations provided 62 percent of the total output, and government-and-contractor operations furnished the remainder. Nearly 91 percent of the total was shipped by truck, 5 percent by rail, and 4 percent by river barge.

Of the 232 commercial operations producing sand and gravel, the 10 largest furnished nearly 28 percent of the total quantity and 27 percent of the total value of commercial output. Largest operation was the Nelson plant of J. L. Shiely Co. in Washington County, with production of 800,000 tons.

Stone.—Total stone production decreased 7 percent in quantity and 1 percent in value, compared with 1960. A 56-percent drop in the quantity of crushed granite for railroad ballast was chiefly responsible for the decrease in total stone output.

Limestone was produced in 15 counties, chiefly from deposits along the Minnesota and Mississippi Rivers in the south-central and southeastern parts of the State. Total production of dimension and crushed limestone increased 1 percent in quantity and 5 percent in value over 1960. Chief reason for the gain tonnagewise was the 3-percent increase in output for concrete aggregate and roadstone. Sales of agricultural limestone decreased 5 percent in quantity and 11 percent in value. Production of dimension limestone decreased in quantity, but increased in value compared with 1960. Increases in the output of sawed and cut stone were offset by a decline in sales of house stone veneer.

Granite was quarried in central Minnesota, in the upper Minnesota River Valley, and in the northeastern part of the State. Most of the rough granite was processed at finishing plants in Cold Spring, Delano, and St. Cloud. Output of dressed granite for architectural and monumental purposes decreased in quantity and value, whereas sales of rough granite for the same purposes increased. Crushed granite production decreased because of a decline in the quantity used for railroad ballast and roadstone.

Quartzite was produced in Nicollet and Rock Counties. Total production increased 26 percent in quantity and 31 percent in value over 1960. Chief reason for the increase was the substantial gain in output for concrete aggregate. The quantity used for riprap rose slightly. However, sales for refractory and filter purposes decreased. About three-fourths of the total output was shipped by truck; the remainder by rail.

Zenith Dredge Co. produced crushed and broken basalt in St. Louis County for concrete aggregate and roadstone, railroad ballast and riprap.

Calcareous marl for agricultural use was produced by three companies from operations in Cass, Crow Wing, and Wadena Counties. Output was virtually the same in 1960. During the year, the marl pit of Tweed Bros. in Crow Wing County was depleted.

Sulfur.—Elemental sulfur was recovered by Great Northern Oil Co. as a byproduct at the Pine Bend refinery in Dakota County. Sales increased slightly in quantity but decreased in value, compared with 1960.

Vermiculite.—Crude vermiculite mined in Montana was exfoliated at plants in Minneapolis and St. Paul. Sales of the exfoliated product decreased 3 percent in quantity because of a smaller demand for building insulation, but increased slightly in value because of higher unit prices. Material was sold for lightweight aggregate in plaster and concrete, insulation, litter, and fireproofing and acoustical purposes.

TABLE 9.—Granite sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction thousand short tons	13	$33	13	$14
Rough architectural thousand cubic feet	32	51	34	106
Rough monumental do	25	83	(1)	(1)
Dressed architectural do	(1)	(1)	(1)	(1)
Dressed monumental do	(1)	(1)	(1)	(1)
Undistributed do	294	2,988	306	2,970
Total approximate thousand short tons [2]	42	3,155	41	3,090
Crushed and broken:				
Riprap thousand short tons	2	2	(3)	(4)
Concrete aggregate and roadstone do	123	237	102	197
Railroad ballast [5] do	512	679	231	378
Stone sand do	34	4		
Total do	671	922	[6] 334	575
Grand total do	713	4,077	[6] 376	3,665

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[2] Average weight of 166 pounds per cubic foot used to convert cubic feet to short tons.
[3] Less than 500 short tons.
[4] Less than $500.
[5] Includes poultry grit to avoid disclosing individual company confidential data.
[6] Data do not add to totals shown because of rounding.

TABLE 10.—Limestone sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction and rubble thousand short tons	12	$63	6	$25
Rough architectural thousand cubic feet	15	43	16	46
Sawed do	20	76	22	94
Cut do	88	760	107	1,038
House stone veneer do	251	641	206	535
Flagging do	5	4	5	3
Total approximate thousand short tons [1]	42	1,587	34	1,741
Crushed and broken:				
Riprap thousand short tons	53	66	29	27
Concrete aggregate and roadstone do	2,912	3,307	2,993	3,492
Agriculture do	406	648	384	579
Asphalt do	39	204	44	246
Other [2] do	2	7	2	7
Total do	3,412	4,232	3,452	4,351
Grand total do	3,454	5,819	3,486	6,092

[1] Average weight of 160 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes flux, mineral food, poultry grit, and other uses.

MINERAL FUELS

Peat.—Production of peat increased considerably in 1961 and reached 11,091 short tons, the largest output since 1949. Production was reported by seven companies, with operations in Beltrami, Carlton, Itasca, Koochiching, Pine, and St. Louis Counties.

Although classed as a mineral fuel, peat in Minnesota was sold mostly for soil improvement. Other uses included ingredient for potting soils, in mixed fertilizers, packing for flowers, and earthworm-culture medium. Peat was sold in bulk and in polyethylene bags ranging in size from 1 quart to 6 cubic feet.

REVIEW BY COUNTIES

Minerals were produced in all counties in Minnesota except Waseca. St. Louis County furnished 71 percent of the total mineral value, because of the large output of iron ore. Mineral output of 12 counties exceeded $1 million. Value of output increased for 41 counties, and decreased for 45. Decreases in Crow Wing, Itasca, and St. Louis Counties were attributable to the marked decline in iron-ore shipments. However, Fillmore County recorded an increase because of a slight rise in iron-ore output. Most of the gains or decreases in other counties depended on demand for road-construction materials. Sand and gravel production was common to all counties reporting mineral output. Therefore, some counties are not included in the "County Review" section of the text. However, all producing counties in 1961, as well as their respective minerals produced, are listed in table 11. That part of the sand and gravel and stone production which could not be credited to the county source is included under "Undistributed" in table 11.

Anoka.—Silica sand for molding and foundry uses was produced by Minnesota Silica Sand Co. at its plant near Minneapolis. The county highway department produced and contracted for paving gravel.

Becker.—Nearly 435,000 tons of sand and gravel was produced chiefly in the vicinity of Detroit Lakes. Becker County Sand & Gravel Co. produced material for building and road construction, engine use, and fill. Ernest C. Anderson and Blacktop Surface Co., Inc., produced paving material. The State and county highway departments produced and contracted for sand and gravel for road use.

Beltrami.—Jay W. Craig Co. operated a portable plant and produced 22,500 tons of paving sand. The Minnesota Highway Department produced a small quantity of paving gravel. Minnesota Peat Co. produced peat near Northome for horticulture.

Big Stone.—Cold Spring Granite Co. and Delano Granite Works, Inc., quarried granite near Ortonville and Odessa, respectively. The rough material was processed at company finishing plants in Cold Spring and Delano. Output was for architectural and monumental purposes. Rausch Bros. Granite Co. operated a custom-sawing plant at Ortonville and processed granite quarried chiefly in Grant County, S. Dak. Hallett Construction Co. produced sand and gravel near Odessa for building and road construction. The State highway department produced 1,600 tons of paving gravel.

TABLE 11.—Value of mineral production in Minnesota, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Aitkin	(2)	$183,446	Sand and gravel.
Anoka	$134,590	(2)	Do.
Becker	(2)	380,990	Do.
Beltrami	75,602	(2)	Sand and gravel, peat.
Benton	110,483	95,681	Sand and gravel.
Big Stone	(2)	(2)	Stone, sand and gravel.
Blue Earth	1,210,421	1,381,005	Do.
Brown	303,968	266,514	Sand and gravel, clays.
Carlton	256,788	347,917	Sand and gravel, peat, clays.
Carver	223,989	312,652	Sand and gravel, lime.
Cass	152,853	57,712	Sand and gravel, stone.
Chippewa	532,826	194,634	Sand and gravel.
Chisago	(2)	173,498	Do.
Clay	1,544,419	1,202,720	Sand and gravel, lime.
Clearwater	113,724	2,763	Sand and gravel.
Cook	38,362	136,218	Do.
Cottonwood	130,981	70,181	Do.
Crow Wing	10,706,391	9,816,038	Iron ore, manganiferous ore, sand and gravel, stone.
Dakota	1,352,764	1,481,194	Sand and gravel, stone.
Dodge	143,150	132,635	Stone, sand and gravel.
Douglas	130,147	72,715	Sand and gravel.
Faribault	320,574	292,352	Do.
Fillmore	3,642,904	4,130,644	Iron ore, stone, sand and gravel.
Freeborn	(2)	406,043	Sand and gravel.
Goodhue	580,188	309,706	Stone, sand and gravel, clays.
Grant	9,231	(2)	Sand and gravel.
Hennepin	3,287,409	3,320,939	Sand and gravel, clays.
Houston	(2)	(2)	Stone, sand and gravel.
Hubbard	128,351	44,749	Sand and gravel.
Isanti	(2)	97,732	Do.
Itasca	103,610,362	83,098,533	Iron ore, sand and gravel, peat.
Jackson	185,211	120,628	Sand and gravel.
Kanabec	7,805	(2)	Sand and gravel, stone.
Kandiyohi	289,097	298,400	Sand and gravel.
Kittson	(2)	12,547	Do.
Koochiching	8,060	(2)	Sand and gravel, peat.
Lac qui Parle	645,203	558,291	Stone, sand and gravel.
Lake	(2)	38,844	Sand and gravel.
Lake of the Woods	68,611	52,280	Do.
La Sueur	1,551,773	1,727,513	Sand and gravel, stone.
Lincoln	182,500	69,939	Sand and gravel.
Lyon	115,788	230,085	Do.
Mahnomen	501,656	407,991	Do.
Marshall	153,054	145,673	Do.
Martin	318,516	170,782	Do.
McLeod	194,271	274,790	Do.
Meeker	80,657	(2)	Do.
Mille Lacs	(2)	(2)	Stone, sand and gravel.
Morrison	393,717	(2)	Sand and gravel.
Mower	483,577	634,505	Stone, sand and gravel.
Murray	51,844	277	Sand and gravel.
Nicollet	273,778	289,801	Stone, sand and gravel.
Nobles	52,083	251,074	Sand and gravel.
Norman	2,586	127	Do.
Olmsted	283,976	255,441	Do.
Otter Tail	266,771	404,916	Do.
Pennington	67,888	72,956	Do.
Pine	95,872	(2)	Sand and gravel, peat.
Pipestone	(2)	(2)	Sand and gravel.
Polk	896,995	1,278,276	Sand and gravel, lime.
Pope	148,564	198,592	Sand and gravel.
Ramsey	(2)	795,865	Sand and gravel, clays, stone.
Red Lake	5,394	1,469	Sand and gravel.
Redwood	63,920	89,736	Sand and gravel, stone, clays.
Renville	(2)	513,440	Stone, sand and gravel.
Rice	337,873	343,880	Sand and gravel, stone.
Rock	635,831	475,872	Sand and gravel, abrasives, stone.
Roseau	53,757	146,497	Sand and gravel.
St. Louis	364,507,040	320,310,525	Iron ore, cement, sand and gravel, lime, peat, stone.
Scott	850,831	870,002	Stone, sand and gravel.
Sherburne	(2)	133,570	Sand and gravel.
Sibley	40,851	117,438	Do.
Stearns	2,458,478	2,544,802	Stone, sand and gravel.
Steele	636,023	369,899	Sand and gravel, stone.
Stevens	71,434	80,346	Sand and gravel.
Swift	180,990	261,723	Do.
Todd	223,933	240,930	Do.
Traverse	1,377	1,301	Do.

See footnotes at end of table.

TABLE 11.—Value of mineral production in Minnesota, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Wabasha	$144,454	$184,061	Stone, sand and gravel.
Wadena	60,452	5,564	Do.
Washington	1,708,899	2,085,917	Sand and gravel, stone.
Watonwan	102,989	90,183	Sand and gravel.
Wilkin	137,175	(2)	Do.
Winona	749,910	808,589	Stone, sand and gravel.
Wright	242,761	218,886	Sand and gravel.
Yellow Medicine	535,578	252,375	Stone, sand and gravel.
Undistributed [3]	5,444,775	4,063,307	
Total	515,255,000	450,509,000	

[1] No production reported for Waseca County.
[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[3] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by footnote 2.

Blue Earth.—Mankato Stone Co. and Vetter Stone Co. produced dimension limestone at Mankato. Output was primarily for architectural use. Some material was sold as rubble and flagging. Crushed and broken limestone for road surfacing, agricultural use, and riprap, was produced near Mankato by Lundin Construction Co. and Mankato Aglime & Rock Co.

Producers of sand and gravel included Guaranteed Gravel & Sand Co., Hallett Construction Co., Hiniker Sand & Gravel Co., and North Star Concrete Co. All operations were fixed plants near Mankato. Output was for building and road construction, fill, and other purposes. Paving sand and gravel was produced under contract for the State highway department.

Brown.—Shale was produced by Ochs Brick & Tile Co. from a pit near Springfield. The company used the material chiefly for manufacturing building brick at its Springfield plant. Some material from the same pit was used by Acolite, Inc., for manufacturing lightweight aggregate, also at Springfield.

Approximately 335,000 tons of sand and gravel was produced for building and road construction and other uses. Carlson Bros., Inc., and Roberts Bros. operated portable plants near Comfrey and Sleepy Eye, respectively. Fixed plants were operated by Math N. Schumacher near Springfield, Wallner Construction Co., Inc., near New Ulm, and M. M. Youngmann near Sleepy Eye. Paving sand was produced by the State highway department and contracted for by the county highway department.

Carlton.—Sand and gravel was produced by six companies, operating portable and fixed plants near Carlton, Cloquet, and Moose Lake. Output was for building and road construction, railroad ballast, and fill. The pit of Al O'Braske Sand & Gravel Co. was depleted in 1961. Paving sand and gravel was produced and/or contracted for by the State and county highway departments and the city of Cloquet. Clay was produced near Moose Lake by Nemadji Tile & Pottery Co. for use chiefly in manufacturing floor tile.

Red Wing Peat Corp. produced sphagnum peat at its large-scale operation near Corona. The material was processed in an oil-fired rotary kiln and marketed mostly in 6-cubic-foot polyethylene-lined bags. Shipments were made by rail and truck.

Carver.—American Crystal Sugar Co. produced quicklime and used the entire output in its sugar refinery at Chaska.

Sand and gravel was produced by Ahles & Lush, Wm. Mueller & Sons, and Rosenwinkel Sand & Gravel Co., Inc. The material was used for building and road construction and other purposes. Paving sand and gravel was produced under contract for the State highway department.

Clay.—Quicklime was produced at Moorhead by American Crystal Sugar Co. for use in sugar refining.

Sand and gravel was produced by six companies from fixed and portable plants near Felton, Glyndon, and Moorhead. Output was for building and road construction and fill. The State highway department produced and contracted for paving gravel.

Cook.—Erie Mining Co. shipped 7.6 million long tons of taconite-concentrate pellets from Taconite Harbor, record shipments since the port opened in 1957. Pellets were produced at Erie's large processing plant at Hoyt Lakes, in St. Louis County. First cargo of the 1961 season was loaded May 9, and the final cargo left Taconite Harbor November 30.

Edwin E. Thoreson, Inc., and Ogema Land & Abstract Co. operated fixed sand and gravel plants near Grand Marais. Material produced was for building and road use and fill. Paving sand and gravel was produced by the State highway department and under contract for the State and county highway departments. Total sand and gravel production was 238,000 tons.

Crow Wing.—Total value of minerals produced decreased 8 percent from 1960, chiefly because of the marked decline in shipments of iron and manganiferous ores. Operating companies and mines from which iron and/or manganiferous ores were shipped in 1961 were as follows:

Company:	*Mines*
The Hanna Mining Co. (formerly The M. A. Hanna Co.)	Alstead group, Feigh, Huntington, Mahnomen, Musser, and Robert.
Inland Steel Co	Armour No. 2.
Pickands Mather & Co	Rabbit Lake.
Pittsburgh Pacific Co., Zontelli Brothers Division.	Mangan-Joan, Mangan Lot No. 5, Manuel, Merritt Stockpile, Sagamore, Virginia Tailings, and West Airport.

All mines operated in the county during the year were open pits, except the Armour No. 2 underground mine. About 55 percent of the iron ore shipped was direct-shipping grade; the remainder was concentrate. Pickands Mather & Co., resumed shipments from the Rabbit Lake mine in September. Early in the year the company closed its Mahnomen mine. The Hanna Mining Co. acquired the Mahnomen in May and during the year made shipments from stocks. Hanna closed its Robert mine and canceled leases on the Alstead group, Feigh, and Musser mines. The Alstead group was a longtime producer of manganiferous ore.

All manganiferous ore produced in the State in 1961 was from eight mines in Crow Wing County. Manganiferous iron ore was shipped from the Mahnomen and Robert mines of Hanna and from the Merritt Stockpile, Sagamore, and Virginia mines of Zontelli Brothers. Zontelli Brothers shipped material from the Merritt

Stockpile and tailings from the Virginia mine to Manganese Chemicals Corp. for processing. The entire output of ferruginous manganese ore was shipped from stocks from the Alstead group of Hanna and the Mangan-Joan and Mangan Lot No. 5 mines of Zontelli Brothers. Total output of manganiferous ore was considerably less than in 1960.

Manganese Chemicals Corp. continued production of manganese carbonate, manganese dioxide, and other manganese products from Cuyuna Range manganiferous ores at its Riverton plant.

Fixed sand and gravel plants were operated near Brainerd by Anderson Brothers, Ripley Sand & Gravel, Inc., and Les Roberts Sand, Gravel & Excavating Co. Output was for building and road construction and fill. The State and county highway departments produced and contracted for paving sand and gravel. Total county sand and gravel production was 299,000 tons. Tweed Brothers produced calcareous marl for agricultural use. The marl pit near Pequot Lakes was depleted during the year.

Dakota.—Crushed limestone for roadstone was produced by Edward Kraemer & Sons, Inc., from its Bornville quarry and by Northwestern Gravel Co., Inc., near Savage. Both companies also produced sand and gravel. An article describing the new 500-ton-per-hour sand and gravel plant of Northwestern Gravel Co., Inc., was published.[7] The new plant, 4 miles south of the old plant, tripled the capacity of the company's original operation in the washing phase alone. The overall operation had an exceptional output rate of 100 tons per man-hour. Output from the plant met specifications for ready-mixed and bituminous concrete aggregate. Other producers of sand and gravel included Bituminous Surface Treating Co., Cords Concrete Products, Jay W. Craig Co., Minnesota Quartz Co., Standard Building Material Co., and Swanson Aggregate, Inc. Sand and gravel was produced for building and paving, railroad ballast, sandblasting, fill, and other purposes. Paving sand and gravel was produced by the State highway department and under contract for the State and county highway departments. Total sand and gravel output was 1,170,000 tons.

The Great Northern Oil Co. recovered byproduct elemental sulfur at its Pine Bend refinery.

A new glass-container plant of Brockway Glass Co. near Rosemount was completed, and began operating late in April. Northwest Cooperative Mills, Inc., announced plans to construct a $4 million fertilizer plant at Pine Bend. The plant was expected to produce 100,000 tons of water-soluble ammonium phosphate annually.

Fillmore.—Shipments of iron ore from mines in Fillmore County were 502,000 long tons, nearly 9 percent greater than in 1960. Virtually the entire output was shipped all-rail to consuming furnaces at Granite City, Ill. About 5,300 tons was sold for use in manufacturing cement. The Hanna Mining Co. shipped 410,000 tons of iron-ore concentrate from the Spring Valley group of mines. Schroeder Mining Co. shipped 92,000 tons of concentrate from the Krueger mine near Chatfield. A new classifier was installed at the company's beneficiation plant late in the year.

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[7] Pit and Quarry. Quality Control Parallels Expansion. V. 53, No. 12, June 1961, p. 80.

Crushed limestone for agricultural and road purposes was produced by Hadland & Vreeman (73,000 tons) and Kappers Construction Co. (116,000 tons), operating portable plants near Ostrander and Fountain, respectively, and Pederson Brothers (129,000 tons), with a fixed plant at Harmony. Hector Construction Co., Inc., operated a portable plant at Lanesboro and produced 3,600 tons of crushed limestone for roadstone and 4,100 tons of paving sand. The State highway department produced 11,500 tons of paving sand.

Goodhue.—Red Wing Sewer Pipe Corp. produced fire clay from pits near Goodhue. Early in the year the company contracted with Mann Construction Co. to strip, mine and haul the clay to its Red Wing plant. The company used the material for manufacturing vitrified sewer pipe, draintile, and other products.

Mann Construction Co. operated a portable crushing plant at various locations and produced crushed limestone chiefly for road construction. Valley Limestone Co. produced crushed limestone for agricultural use from a quarry near Zumbrota. Sand and gravel was produced by seven companies, from pits near Frontenac, Lake City, Red Wing, and Zumbrota. Output was for building and road construction and fill. The State highway department produced and contracted for paving sand and gravel.

Hennepin.—Approximately 3.2 million tons of sand and gravel was produced, chiefly in the suburban areas of Minneapolis. Output was for building and road construction, railroad ballast, fill, molding, engine use, and other purposes. Commercial operators included Anderson Aggregates, Inc.; Barton Contracting Co.; Consolidated Materials Co.; Jay W. Craig Co.; Chas. M. Friedheim Co.; Frisk Sand Co.; Glacier Sand & Gravel Co.; J. V. Gleason; Hedberg & Sons Co.; Hopkins Sand & Gravel Co.; Industrial Aggregate Co.; Keller Bros. Gravel Co.; Landers-Norblom-Christenson Co.; Mapco Sand & Gravel Co.; and Oscar Roberts Co. The Hennepin County Road-Bridge Department produced over 97,000 tons of gravel for paving use, fill, and other purposes.

Clay was produced near Minneapolis by North Central Lightweight Aggregate Co., Inc., and used by the company in manufacturing lightweight aggregate. Output increased substantially in 1961. An article describing the company operation was published.[8]

Minnesota Perlite Corp. and Western Mineral Products Co. expanded perlite at plants in Minneapolis, from raw material mined in Nevada and New Mexico. Output was sold for lightweight aggregate in plaster and concrete, soil conditioning, and paint additive. Exfoliated vermiculite was produced in Minneapolis by B. F. Nelson Manufacturing Co. and Western Mineral Products Co. from crude vermiculite mined in Montana. The exfoliated product was used for lightweight aggregate in plaster and concrete, insulation, litter, and fireproofing and acoustical purposes.

Houston.—Hector Construction Co., Inc., operated a portable crushing plant at various locations and produced 187,000 tons of limestone for roadstone and agricultural use, as well as 17,000 tons of paving sand. Botcher Construction Co. produced crushed and broken limestone for agricultural and road purposes and riprap. The State and county highway departments produced a total of 2,400 tons of paving sand.

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[8] Pit and Quarry. North Central Lightweight Aggregate Company: Exceptional Market, Raw Material Factors Spur Development of Aglite Plant. V. 53, No. 10, April 1961, pp. 144.

Itasca.—Total value of Itasca County mineral output decreased 20 percent from 1960 chiefly because of the marked decline in iron-ore shipments. Mining operations were adversely affected by the low demand for ore by the steel industry plus competition from higher grade ores from other sources.

About 97 percent of the shipments of usable iron ore was concentrate; the remainder was direct-shipping grade. All mines operated in 1961 were open pits. Operating companies and mines from which iron ore was shipped were:

Company:	*Mines*
Cleveland-Cliffs Iron Co	Canisteo, Hawkins, Hill-Trumbull, Holman-Cliffs, and Sally.
The Hanna Mining Co. (formerly The M. A. Hanna Co.)	Argonne group, Harrison group, Hunner, Mississippi group, and Patrick group.
Jessie H. Mining Co	Jessie.
Jones & Laughlin Steel Corp	Hill Annex and Lind-Greenway.
Oliver Iron Mining Division, United States Steel Corp.	Arcturus group and Plummer.
Pickands Mather & Co	Bennett, Danube, Tioga No. 2 and West Hill.

Oliver and Hanna conducted research at their new semitaconite pilot plants near Coleraine and Cooley, respectively. Both plants used reduction roasting, converting nonmagnetic semitaconite to magnetite in rotary kilns. Subsequent processing was similar to that employed in taconite plants in the eastern Mesabi Range. The Hanna plant began experimental production in February; the Oliver plant had begun production late in 1960. The Hanna kiln had a capacity of 10 tons of feed per hour; the Oliver kiln treated up to 5 tons per hour. An article describing the Hanna plant was published.[9] The Hanna plant was closed in October for modifications, and was not operated the balance of the year. Hanna and Oliver hoped to obtain enough engineering data to determine the commercial possibilities of utilizing the enormous semitaconite resources of the Mesabi Range.

Oliver did not operate its King group of mines or its Trout Lake concentrator in 1961, primarily because of the slump in demand for ore and competition from higher-quality ores from other sources. The Trout Lake plant was one of the largest iron-ore beneficiation plants in Minnesota.

A new cyclone unit was installed at the Canisteo plant of Cleveland-Cliffs Iron Co. near Coleraine. The company also added a reject conveyor and stacker system at the Hill-Trumbull property, near Marble.

Jones & Laughlin Steel Corp. completed construction of its new concentrator at the Hill Annex mine near Calumet. The plant began processing Cretaceous lean ore, classified as semitaconite, accumulated mostly during the early years of operating the Hill Annex mine. The plant used autogenous grinding, followed by spirals. The company planned to add a flotation unit to the plant at a later date. Annual capacity of the plant was about 500,000 tons of concentrate. Jones & Laughlin also was enlarging its concentrator at the Lind-Greenway mine, near Grand Rapids, by adding heavy-density and jigging sections. The additions were to be completed in early 1962.

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[9] Skillings' Mining Review. Production Starts at Hanna Semi-Taconite Pilot Plant. V. 50, No. 11, Mar. 18, 1961, p. 1.

Pickands Mather & Co. resumed shipments from the West Hill mine but abandoned the Tioga No. 2 mine. Equipment at the Tioga No. 2 was transferred to other mines. Both mines are near Grand Rapids. The company Danube mine near Bovey was idle the entire year.

Neil Baker produced building gravel at a fixed plant near Grand Rapids. The State and county highway departments produced paving sand and gravel.

Colby Pioneer Peat Co. produced peat from a 580-acre deposit near Wawina and hauled it by truck several miles to the company's Wawina plant for processing. Sales were chiefly for soil conditioning.

Kanabec.—Cold Spring Granite Co. produced granite for architectural and monumental purposes from its Mora Grey quarry. The rough stone was processed at the company finishing plant in Cold Spring. The State highway department produced and contracted for paving sand and gravel.

Koochiching.—The State highway department produced 25,000 tons of paving gravel. Moss Products Co. produced peat near Northome, chiefly for horticultural purposes.

Lac qui Parle.—Cold Spring Granite Co. quarried granite near Odessa and shipped the rough stone to the company Cold Spring plant for processing. Output was for architectural and monumental use. North Star Granite Corp. produced granite for monumental purposes from its No. 9 quarry near Odessa. The rough material was processed by the company in St. Cloud. Dakota Granite Co. and Dewar Bellingham Granite Co. produced granite for monumental use near Bellingham. Material quarried by Dakota Granite Co. was processed at the company finishing plant in Grant County, S. Dak.

W. J. Stolpman operated a portable screening plant and stationary washing plant near Rosen and produced 9,300 tons of sand and gravel for building and road construction and fill. The State and county highway departments produced and contracted for road gravel.

Lake.—Reserve Mining Co. operated its large taconite-processing plant at Silver Bay virtually at full capacity throughout the year. Approximately 15.5 million long tons of crude taconite, mined near Babbitt in St. Louis County, was processed at the plant in 1961. During the year about 5.9 million long tons of taconite-concentrate pellets was shipped, setting a new record. Pellets average about 61 percent iron, natural. The shipping season for Silver Bay opened April 15. The final cargo of pellets for the 1961 season left the harbor December 3.

A $120 million program to expand annual capacity of the Silver Bay plant to 9 million tons of pellets was underway. Enlargement of plant facilities at Silver Bay was progresssing satisfactorily at the close of the year and 45 miles of new track paralleling the original rail line connecting Babbitt and Silver Bay were completed. A second car dumper for emptying 90-ton railroad cars of crude taconite was completed. New storage bins and crushers for the fine crushing plant were added. The concentrator building was lengthened from 1,350 feet to 2,150 feet. Most of the steel structure for this extension was erected by the end of the year. New mill storage bins and hydroseparator tanks were added. Two new pelletizing furnaces were being installed. Plans included enlargement of the pellet storage area to 5 million tons and powerplant and vessel-loading facilities.

In November Reserve Mining Co. began using natural gas in the company pelletizing furnaces, representing the first use of natural gas in processing iron ore in Minnesota.

Two Harbors Aggregate Co. and Jay W. Craig Co. produced sand and gravel. Output was used for building and road construction and fill. The county highway department produced 56,000 tons of gravel for fill. The State highway department produced and contracted for paving sand and gravel.

Le Sueur.—The Babcock Co. produced dimension limestone near Kasota. Principal products sold by the company were cut stone and stone veneer. Part of the output was marketed as marble for interior trim and facings. Some material was sold for rough construction and riprap. Ed. Swartout operated a portable crushing plant near Kasota and produced limestone and gravel for road use.

Gopher State Silica, Inc., produced silica sand from the Jordan Sandstone formation near Le Sueur. Output was used for manufacturing glass, molding, oilfield fracturing, filler, and building purposes. E. H. Benjamin produced silica sand near Kasota and sold the material for grinding and polishing. Glander Washed Sand & Gravel Co. operated a fixed plant near Gaylord and produced about 128,000 tons of sand and gravel for road construction and fill. C. C. Cram produced over 21,000 tons of paving sand near Waterville. Lundin Construction Co. and Zarnott Construction Co. operated portable plants near Kasota and Gaylord, respectively, and produced paving gravel. The State highway department produced and contracted for paving sand and gravel.

Mille Lacs.—Dimension granite for architectural and monumental purposes was produced by Cold Spring Granite Co. from the Diamond Grey quarry near Isle. The rough material was processed at the company Cold Spring plant.

Mille Lacs Sand & Gravel Co. produced about 14,000 tons of sand and gravel from a fixed plant near Milaca. The State highway department produced over 5,000 tons of paving sand.

Mower.—Osmundson Bros. operated a portable crushing plant and produced about 250,000 tons of limestone. Output was for agricultural use, roadstone, and other purposes. Martin Bustad & Son quarried limestone near Austin and sold nearly 54,000 tons for agricultural and road use. Hickok Calcium White Rock Co. produced limestone near LeRoy for roadstone, agricultural use, flux, mineral food, poultry grit, and rough construction.

Approximately 418,000 tons of sand and gravel was produced in the county. Commercial operators were Austin Ready-Mix Concrete Co., Brownsdale Sand & Gravel Co., Hallett Construction Co., Kolpin Sand & Gravel Co., Lea Sand & Gravel Co., and Ulland Bros., Inc. Operations were chiefly near Austin and Brownsdale. Output was for building and road construction, fill, and other uses. The State and county highway departments contracted for paving sand and gravel.

Nicollet.—New Ulm Quartzite Quarries, Inc., produced crushed quartzite at the company quarry near New Ulm. Output increased substantially over 1960. Sales were for concrete aggregate and roadstone, filter blocks for water and sewage treatment plants, refractory use, and riprap.

Hallett Construction Co. operated a fixed sand and gravel plant near St. Peter and produced material for building and road construction and other uses. Courtland Sand & Gravel Co. produced sand near Courtland for building use and fill. A. H. and J. H. Massopust reported no output from their pit near New Ulm. Paving gravel was produced under contract for the county highway department.

Olmsted.—A total of 359,000 tons of sand and gravel was produced. Sand and gravel for building and road construction, fill, and other purposes was produced near Rochester by Quarve & Anderson Co., Riverside Sand & Gravel Co., and Rochester Sand & Gravel Co. The State and county highway departments contracted for paving sand and gravel. Quarve & Anderson Co. also produced crushed limestone in various counties, for which production data were not separately available. No limestone production in Olmstead County was reported by Patterson Quarries, Inc. The company quarry was abandoned in 1960.

Otter Tail.—Over 670,000 tons of sand and gravel was produced by commercial and Government-and-contractor operations. The following companies furnished about four-fifths of the county production: John Dieseth Co., L. A. Hansen, T.L. Horstman, Mark Sand & Gravel Co., Monson & Langston, and The Minneapolis, St. Paul & Sault Ste. Marie Railroad Co. Operations were chiefly near Fergus Falls and Vergas. Output was used for building and road construction, railroad ballast, and fill. The State highway department and the city of Fergus Falls produced and contracted for paving sand and gravel.

Pine.—The value of mineral production increased considerably because of high demand for road-construction material. The State highway department produced and contracted for over 500,000 tons of paving sand and gravel, principally for interstate highway construction. Hallett Construction Co. produced paving gravel in a portable plant near Finlayson. Yost Bros. produced sand and gravel near Beroun and used the entire output for making ready-mixed concrete. Louis Hultgren & Sons produced about 2,200 tons of molding sand near Kerrick.

Pine City Peat Co. produced peat 3 miles north of Pine City, chiefly for soil conditioning.

Polk.—Over 1 million tons of sand and gravel was produced for building and road construction, railroad ballast, fill, and other uses. Commercial operators included Ahles & Lush, Great Northern Railway Co., Northern Sand & Gravel, Inc., Spring Gravel Co., and Thorson Gravel Co. The county highway department produced and contracted for paving sand and gravel.

American Crystal Sugar Co. produced quicklime at Crookston and East Grand Forks for use in refining sugar.

Ramsey.—Arsenal Sand & Gravel Co. produced 608,000 tons of sand and gravel at its New Brighton plant for building and road purposes and fill. Jay W. Craig Co. operated a portable plant and produced 175,000 tons of paving sand. A total of 260,000 tons of sand and gravel was produced by, and under contract for, the State highway department.

Miscellaneous clay was produced by Twin City Brick Co. and used for manufacturing building brick. Dimension limestone was produced at St. Paul by Sebesta Stone Co. and sold for use in rough construction. The MacArthur Co. exfoliated vermiculite at its St. Paul plant from crude vermiculite mined in Montana. The exfoliated product was sold for lightweight aggregate in plaster and concrete and for insulation.

Redwood.—View Quarry Co. and Johnson Quarry Co. quarried granite near Belview for monumental use. Miscellaneous clay was produced near Morton by Ochs Brick & Tile Co. and hauled to its Springfield brick plant for processing. Chapman Gravel Co. operated a fixed sand and gravel plant near Belview and produced 39,000 tons of material for building use and fill. Buterbaugh Sand Co. produced about 9,000 tons of sand for building and other purposes near Walnut Grove. The State highway department produced 2,500 tons of paving gravel.

Renville.—Dimension granite for architectural and monumental purposes was produced by Cold Spring Granite Co. from the Rainbow quarry near Morton. The rough material was processed at the company plant in Cold Spring.

Approximately 299,000 tons of sand and gravel was produced. Commercial operators were Danube Washed Sand & Gravel, John Enestvedt Gravel Pit, Fairway Construction Co., Minnesota Sand & Gravel Co., and Morton Aggregates, Inc. Operations were near Belview, Danube, Hector, and Sacred Heart. Output was for building and road construction, fill, and other uses. The county highway department contracted for paving gravel.

Rice.—About 260,000 tons of sand and gravel and 103,000 tons of limestone were produced. Sand and gravel, produced by five commercial operators chiefly near Faribault, Nerstrand, and Northfield, was used for building and road construction, railroad ballast, and fill. Paving sand and gravel was produced under contract for the State and county highway departments. Crushed limestone for agricultural use and roadstone was produced by Bryan Rock Products, Inc., in a portable plant near Northfield. Douglas Kielmeyer produced roadstone near Nerstrand. Faribault Quarries produced dimension and crushed limestone near Faribault for use as roadstone, rubble, and flagging.

Rock.—Grinding pebbles and tube-mill liners were produced by Jasper Stone Co. from a quartzite quarry near Jasper. Some broken material was sold as riprap. About 470,000 tons of sand and gravel was produced, near Luverne and Leota. Producers included Hallett Construction Co., C. H. Hatting Gravel Co., Inc., and Pronk & Son. Output was for building and road construction, fill, and other uses. The State and county highway departments produced and contracted for paving gravel.

St. Louis.—The value of St. Louis County mineral output decreased 12 percent from 1960, mainly because of a 19-percent drop in iron-ore shipments, that resulted from lower demand by the steel industry coupled with competition from high-quality ores from other sources. Mines in St. Louis County furnished 74 percent of the total usable iron ore shipped from the State. Direct-shipping grades comprised only 35 percent of the total; concentrates furnished the remainder. Operating companies and mines from which iron ore was shipped in 1961 were as follows:

Company:	*Mines*
Charleson Iron Mining Co	Missabe Mountain and Minnewas LOSP.
Cleveland-Cliffs Iron Co	Wanless.
The Hanna Mining Co. (formerly The M. A. Hanna Co.)	Agnew No. 2-South Agnew, Douglas, Duncan, Enterprise, Morton-South Eddy, North Uno, Pierce group, South Longyear, and Weggum.
Jones & Laughlin Steel Corp	Schley group.
W. S. Moore Co	Judson, Judson Extension, Mariska, Mariska Extension, Norman, and Yawkey.
North Range Mining Co	Nahma.
Oglebay Norton Co	St. James.
Oliver Iron Mining Division, United States Steel Corp.	Canton (0–39), Kosmerl, Monroe group, Pillsbury, Pilotac, Pioneer, Rouchleau group, Sherman group, Soudan, and Stephens.
Pacific Isle Mining Co., Division of Inland Steel Co.	Iroquois and Wacootah.
Picklands Mather & Co	Bennett Annex, Corsica, Embarrass, Erie Commercial, Erie Preliminary Taconite Plant, and Mahoning.
Pioneer Mining Co	Mary Ellen.
Pittsburgh Pacific Co	Albany, Clark, Day, Meadow, Meadow Extension, Missabe Mountain, and Wyoming.
Reserve Mining Co	Peter Mitchell.
Rhude & Fryberger	Boeing, Hull-Nelson, Pearsall, and Troy East.
Snyder Mining Co	Godfrey, Webb-Sellers Triangle, and Whiteside.
E. A. Young, Inc	Minnewas.
Zenith Mining Co	Zenith.

All operating mines were in the Mesabi Range, except the Pioneer, Soudan, and Zenith underground mines in the Vermilion Range. The only other underground operations were the Albany group (including the Clark and Day properties) and the Godfrey mine.

Contrary to the decline in shipments of regular ores, shipments of taconite concentrate increased to nearly 14.4 million tons, almost one-third of the State total iron-ore output. Taconite concentrate shipments were the greatest on record. Erie Mining Co. produced taconite at its large-scale operations at Hoyt Lakes throughout the entire year, except for a 2-week shutdown in July during which maintenance work was performed. Erie shipped nearly 7.6 million tons of taconite-concentrate pellets from the Hoyt Lakes plant and about 5,200 tons of taconite concentrate fines from stocks at the Preliminary Taconite Plant. The company mined over 21 million tons of crude taconite during the year. Finished pellets were hauled 73 miles over the company railroad to the shipping port, Taconite Harbor. Reserve Mining Co. produced 16.4 million tons of taconite at the Peter Mitchell mine near Babbitt and crushed it to about 3-inch size before being shipped to the company Silver Bay plant for further processing. As part of an expansion program, a second primary crushing plant was completed at Babbitt. Other details of the expansion program are mentioned in the Lake County section. Oliver Iron Mining continued to operate the Pilotac taconite mine and concentrator near Mountain Iron. Taconite concentrate was hauled to Oliver's Extaca plant at Virginia for agglomerating.

Oliver began operating its new Sherman concentrator near Chisholm. Ores from the Monroe and Sherman groups of mines were treated at the plant, which contains a scrubber, crusher, screens and washing equipment, heavy-media section, cyclones, and spirals. Annual capacity of the plant was about 1.5 million tons of concentrate. Oliver also completed construction of a new washing plant at the Pioneer underground mine at Ely, in the Vermilion Range. Plant equipment included a crusher, screens, classifier, and spirals. The plant was built within the mine headframe for year-round operation, which is unique for northern Minnesota.

Shipments were resumed from the Wanless mine of Cleveland-Cliffs Iron Co. The mine was operated under contract by Snyder Mining Co. in conjunction with Snyder's Whiteside mine. The Elbern mine of Haley-Young Mining Co. was inactive the entire year. The Hanna Mining Co. ceased operations at the Enterprise mine near Virginia, and the South Longyear and Weggum mines near Hibbing after ore reserves at these mines were depleted. The Columbia mine and Longyear group of Jones & Laughlin Steel Corp. were not operated in 1961; the Columbia was depleted.

Pickands Mather & Co. resumed shipments from the Corsica mine, operated in conjunction with the Embarrass mine near Biwabik. After it was closed in 1954 the Corsica became flooded to a depth of about 265 feet with an estimated 1.5 billion gallons of water. Dewatering began in March 1960. The washing plant and mining equipment were repaired, and wet screening facilities installed. In January 1961, a large warehouse of Pickands Mather & Co. at the Embarrass property was destroyed by fire. The frame building housed the garage, supply warehouse, electric shop, and heating plant. Damage was estimated at $1 million. The Wade mine of Pickands Mather & Co. was idle throughout the entire year. In March Pickands sold its Albany underground mine to Pittsburgh Pacific Co., who operated the Albany during the balance of 1961 in conjuction with the Clark and Day properties. No shipments were made in 1961 from the Chataco, Commodore, Fayal LOSP, Pearce, and Sidney mines which were operated in 1960 by Pittsburgh Pacific Co. The company also cancelled its lease on the Meadow Extension.

At the close of the year Pioneer Mining Co. sold its Mary Ellen mine, near Biwabik, to Pittsburgh Pacific Co. The latter company acquired other physical assets of Pioneer Mining Co., including all mining equipment and the heavy-medium plant.

Pacific Isle Mining Co., Division of Inland Steel Co., shipped ore from the Iroquois and Wacootah mines, but did not operate the Missabe Mountain LOSP, Shiras, and Wisstar mines. The company canceled leases on the Shiras and Wisstar, and assigned the lease on the Missabe Mountain LOSP to Pittsburgh Pacific Co. The Scranton mine of W. S. Moore Co. and the Susquehanna mine of Republic Steel Corp. were not operated in 1961. Both mines are near Hibbing.

Rhude & Fryberger made initial shipments from the Troy East (or Security) open-pit mine near Eveleth. Shipments were resumed from the Hull-Nelson, also operated near Eveleth by Rhude & Fryberger.

Snyder Mining Co. ceased mining operations at the Godfrey mine in August, but continued to ship ore from stockpile. The Godfrey reportedly was uneconomical to operate, and the company was disposing of all equipment at the mine.

In March Zenith Mining Co. closed the Zenith underground mine at Ely for about 3 months chiefly because of lack of demand for iron ore. The mine was reopened in June when market conditions improved.

The American Steel & Wire Division of United States Steel Corp. operated blast and steel furnaces at Duluth. The Duluth blast furnace of Interlake Iron Corp. was inactive throughout the year. Both companies produced coke in 1961; American Steel & Wire Division operated year-round, and Interlake Iron Corp. operated for less than 1 month.

Universal Atlas Cement Division of United States Steel Corp. produced portland and masonry cements at Duluth. Total output increased over 1960 because of greater demand in highway construction. Cutler-Magner Co. produced quicklime and hydrated lime at Duluth. Sales increased over 1960. Crushed and broken basalt was produced by Zenith Dredge Co. Output was used for concrete aggregate and roadstone, railroad ballast, and riprap. Granite for monumental use was quarried near Mountain Iron by Mesaba Granite Co.

St. Louis County Peat Products Co., Inc., produced reed-sedge peat from a 350-acre bog at Central Lakes. Output increased substantially over 1960. Average depth of the deposit was 10 feet, although soundings by a railroad company in the past indicated a maximum thickness of 63 feet. The peat was processed by shredding and screening. Sales were chiefly for soil improvement and as an ingredient for potting soils. Arrowhead Peat Co. produced moss peat on company and State-owned land about 5 miles southeast of Wawina. The company hauled the raw peat to the plant at Floodwood for processing. Plant equipment included a hammermill and a screen. The peat was sold in bulk and packages for use in greenhouses and general soil improvement. Wilderness Valley Farms Division of The Chun King Corp. produced reed-sedge peat on the company 200-acre deposit 3 miles south of Fens. Output was used chiefly for mushroom beds and for producing a house-plant soil.

Nearly 2.2 million tons of sand and gravel was produced in St. Louis County for building and road construction, railroad ballast, engine use, fill, and other purposes. Commercial producers included Arrowhead Sand & Gravel, Inc.; Biwabik Gravel Co., Inc.; E. W. Coons Co.; Jay W. Craig Co.; Duluth, Missabe & Iron Range Railroad Co.; East Range Gravel Co., Inc.; Enrico Ghilardi; Great Northern Railway Co.; Hallett Construction Co.; Juitu Sand & Gravel Pit; Mesaba Construction Co.; N. W. Gravel Co.; and Pioneer Mining Co. Operations were in the vicinities of Biwabik, Brimson, Cloquet, Duluth, Hibbing, Saginaw, and Virginia. The State and county highway departments produced and contracted for paving sand and gravel. The city of Duluth contracted for paving gravel.

Scott.—About 194,000 tons of crushed and broken limestone was produced near Savage and Shakopee for roadstone, agricultural use, asphalt filler, and riprap. Producing companies were B & R Rock Products Co., Bryan Rock Products Co., Inc., and Landers-Norblom-Christenson Co. Over 503,000 tons of sand and gravel was produced from portable and fixed operations near Belle Plaine, Chaska, Prior Lake, and Shakopee. Output was for building and road construction, railroad ballast, and fill. Commercial operators included Belle Plaine Sand & Gravel; Ira Berg; Haferman & Stark; Hallett Aggregates, Inc.; Chicago & Northwestern Railway Co.; and Shakopee Sand & Gravel. The State and county highway departments produced and/or contracted for paving sand and gravel. American Wheaton Glass Corp. began operating its new $5 million glass-container plant in Valley Industrial Park near Shakopee.

Stearns.—Cold Spring Granite Corp. produced granite chiefly for architectural and monumental purposes from six quarries near Cold Spring, Rockville, St. Cloud, and St. Joseph. The rough material was processed at the company finishing plants in Cold Spring and St. Cloud. Some granite was crushed at the Cold Spring plant and sold for poultry grit. Delano Granite Works, Inc., operated a quarry near Rockville from January to August and produced material for architectural use. Dimension granite for monumental purposes was produced by North Star Granite Corp. from its Nos. 4 and 5 quarries near St. Cloud. The rough stone was processed at the company plant in St. Cloud. Shiely-Petters Crushed Stone Co., Inc., quarried granite near Waite Park. The bulk of the output was crushed granite, chiefly for railroad ballast and seal-coating bituminous roads. The company sold some dimension granite for use in constructing the upper lock and dam at St. Anthony Falls in Minneapolis. No production was reported by the Minnesota State Reformatory at St. Cloud for 1961.

Sand and gravel for building and road construction was produced by A. C. Petters Co., Inc., and Megarry Bros. The State highway department produced and contracted for paving sand and gravel.

Steele.—Klemmer Construction Co. produced over 69,000 tons of crushed and broken limestone near Owatonna for roadstone, agricultural use, and riprap.

Owatonna Aggregates Corp. operated a heavy-medium sand and gravel plant near Owatonna and produced about 100,000 tons of material for building use. Medford Washed Sand & Gravel Co. produced 41,000 tons of sand and gravel near Medford for building and road construction and fill. Kohlmier Sand & Gravel Co. operated until May and produced about 40,000 tons of paving sand and gravel. In June the company leased the property to Ed Lundin Construction Co., who produced 70,000 tons of paving sand and gravel during the balance of the year. Nearly 83,000 tons of paving gravel was produced under contract by other companies for the county highway department and the village of Blooming Prairie.

Wabasha.—Hector Construction Co., Inc., and Patterson Quarries, Inc., operated portable plants near Weaver and Plainview, respectively, and produced a total of 121,000 tons of crushed limestone for roadstone and agricultural purposes.

About 57,000 tons of sand and gravel was produced for building and road construction, railroad ballast, and fill. Producing companies were Bennet & Son; Chicago, Milwaukee, St. Paul & Pacific Railroad Co.; Roverud Construction Co.; Art Schober; and Wabasha Sand & Gravel Co. Paving gravel was produced by the State highway department and under contract for the county highway department.

Washington.—About 1.7 million tons of sand and gravel was produced in the county. Commercial producers included Ashbach Construction Co.; Cemstone Products Co.; Jay W. Craig Co.; Durox of Minnesota, Inc.; R. J. Jager Gravel Co.; Shalander & Shaleen; and J. L. Shiely Co. Output was for building and road construction, railroad ballast, fill, and raw material in manufacturing lightweight concrete. The Nelson plant of J. L. Shiely Co. at St. Paul Park was the largest sand and gravel operation in Minnesota in 1961, with production of 800,000 tons. J. L. Shiely Co. also produced crushed and broken limestone near St. Paul for roadstone and riprap. Nienaber Contracting Co. operated a portable plant near Lake Elmo and produced crushed limestone for roadstone, agricultural use, and other purposes. Bryan Rock Products, Inc., produced crushed limestone for roadstone at Smith quarry near Marine on St. Croix. The State highway department contracted for paving sand and gravel.

Winona.—Biesanz Stone Co. produced dimension limestone near Winona chiefly for architectural use. Fred Fakler operated a portable plant and produced crushed limestone from four quarries for roadstone and agricultural use. Hector Construction Co., Inc., produced crushed limestone near Dresbach for use as roadstone. Patterson Quarries, Inc., produced crushed limestone from the Spitzer quarry near St. Charles. Output was for roadstone and agricultural purposes.

Sand and gravel for building and road construction was produced by Winona Aggregate Co., operating a dredge near Winona. The State highway department produced and contracted for paving sand and gravel.

Wright.—Delano Granite Works, Inc., operated a sawing and finishing plant at Delano and processed rough granite quarried by the company in Big Stone and Stearns County.

Nearly 289,000 tons of sand and gravel was produced in the county. Commercial operators were Jay W. Craig Co.; Charles & Anna Frank; Hanover Sand & Gravel Co.; and Edward Schram. Operations were near Delano, Hanover, and South Haven. Paving sand and gravel was produced by the State highway department under contract for the State and county highway departments.

Yellow Medicine.—The Green Co., contractor for Great Northern Railway Co., produced crushed granite near Granite Falls for railroad ballast, riprap, and other uses. Some dimension granite was sold for rubble. August A. Evanson produced dimension granite near Echo for monumental purposes.

Burdett C. Long operated a portable sand and gravel plant near Hazel Run and produced paving gravel. Deutz & Crow Co., Inc., operated a fixed plant at Canby and produced sand and gravel for building and road construction. Paving gravel was produced by the State highway department and under contract for the county highway department and the city of Granite Falls.

The Mineral Industry of Mississippi

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Mississippi Geological Survey.

By Harry D. Kline[1] and Tracy W. Lusk[2]

◆

VALUE of Mississippi mineral production increased steadily for a decade and in 1961 reached a record $210.2 million. Mineral fuels—petroleum, natural gas, and natural gas liquids—represented 89 percent of this value.

Standard Oil Co. of Kentucky began constructing a $125 million oil refinery near Pascagoula. The plant, scheduled to go on stream in early 1964, will have a 32,000-barrel-a-day catalytic-cracking unit, an 18,000-barrel-a-day isocracker, a 19-million-cubic-foot-a-day hydrogen-manufacturing unit, and a boiler plant. Marketing facilities will include pipelines and a deepwater channel to the Gulf of Mexico. Other new plants related to the mineral industry and under construction or completed in the State in 1961 included establishments for manufacturing electrolytic manganese, chlorine, plastics, ceramics, wire and cable, and porcelain enamelware.

The State Budget Commission authorized a $6 million bond issue to finance continued seaport development at Gulfport and Pascagoula.

TABLE 1.—Mineral production in Mississippi[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays......thousand short tons..	1,017	$4,786	1,104	$5,034
Natural gas......million cubic feet..	172,478	32,426	172,543	32,093
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons..	23,648	1,552	25,135	1,625
LP gases......do....	10,151	564	15,510	700
Petroleum (crude)......thousand 42-gallon barrels..	51,673	146,235	[2] 54,492	[2] 153,667
Sand and gravel......thousand short tons..	6,181	5,568	5,920	5,903
Stone......do....	807	808	[3] 913	[3] 1,044
Value of items that cannot be disclosed: Certain metals and nonmetals......	......	7,271	......	11,070
Total Mississippi[4]......	......	[5] 198,449	......	210,242

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Preliminary figure.
[3] Includes shell.
[4] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.
[5] Revised figure.

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[1] Mining engineer, Bureau of Mines, Bartlesville, Okla.
[2] Director, Mississippi Geological Survey, University, Miss.

The seaport development will facilitate handling of petroleum and other mineral products.

The National Aeronautics and Space Agency announced plans for a major test facility in Pearl River County. The proposed project was expected to stimulate the economy of the southern part of the State.

Mississippi Power Co. had under construction a 112,000 kva addition to its steam-generating plant, midway between Biloxi and Gulfport. It planned to begin operating the new generator in June 1962.

Employment and Injuries.—Average employment in mineral industries declined slightly during 1961, according to the Mississippi Employment and Security Commission. The decrease was due mainly to curtailment of oil and gas exploration. Employment in petroleum and natural gas industries averaged 5,200 workers, 350 less than in 1960. Nonmetal mining and processing industries employed about 800 workers.

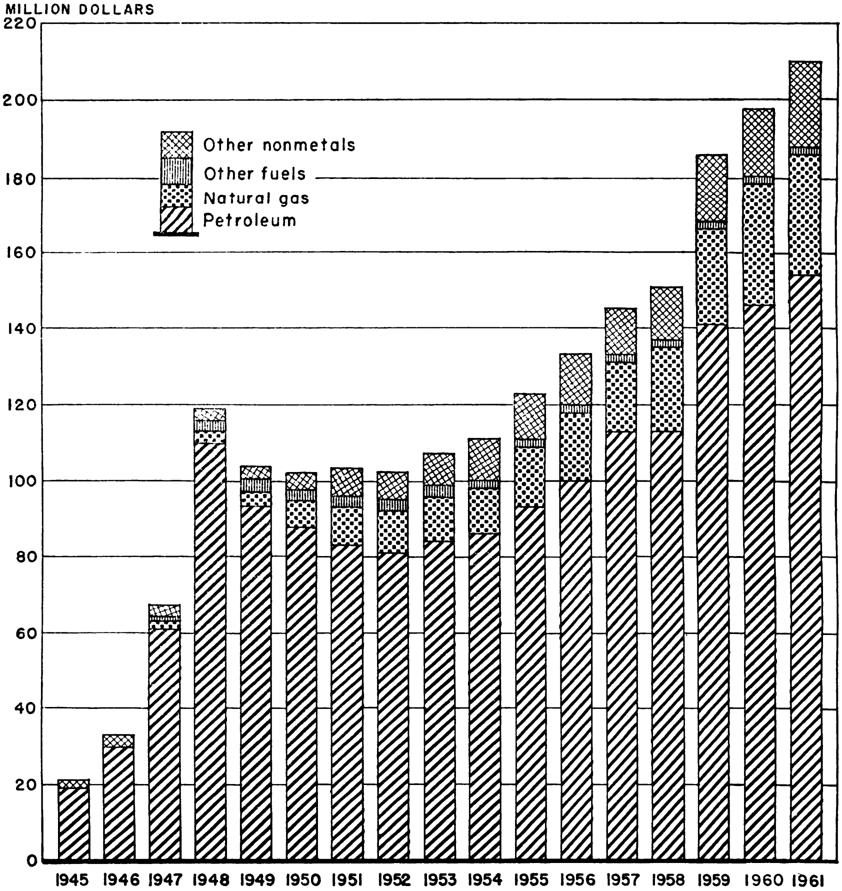

FIGURE 1.—Value of petroleum, natural gas, and total value of mineral production in Mississippi, 1945–61.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of natural gas, natural gas liquids, and crude petroleum continued to increase and reached a new record. Mississippi ranked ninth among the oil-producing States. The five leading petroleum-producing counties were Pike, Lincoln, Adams, Jasper, and Jones.

Based on number of wells completed, oil wells decreased 30 percent and gas wells increased 10 percent. Of 607 holes drilled, 397 were development wells which resulted in 201 oil and 45 gas producers, 210 were exploratory wells which resulted in 10 oil producers, and the remainder were dry holes. The average depth of all holes drilled was 9,831 feet—about the same as the 1960 average.

Two oilfields, McComb in Pike County and Little Creek in Lincoln and Pike Counties were converted to secondary recovery.

TABLE 2.—Oil and gas wells drilled in 1961, by counties

County	Development			Exploratory			Total
	Oil	Gas[1]	Dry	Oil	Gas	Dry	
Adams	18	--------	24	2	--------	29	73
Amite	20	--------	19	--------	--------	15	54
Claiborne	--------	--------	--------	--------	--------	2	2
Clarke	11	--------	3	--------	--------	5	19
Clay	--------	--------	1	--------	--------	1	2
Copiah	--------	--------	--------	--------	--------	4	4
Covington	1	--------	--------	1	--------	2	4
Davis	--------	1	--------	--------	--------	--------	1
Forrest	1	4	3	--------	--------	--------	8
Franklin	9	1	9	--------	--------	11	30
George	--------	--------	--------	--------	--------	1	1
Greene	--------	--------	--------	--------	--------	1	1
Hancock	1	--------	1	--------	--------	3	5
Harrison	--------	--------	--------	--------	--------	1	1
Hinds	1	--------	--------	1	--------	6	8
Issaquena	--------	--------	--------	--------	--------	3	3
Jasper	10	1	4	--------	--------	6	21
Jefferson	5	1	9	2	--------	5	22
Jefferson Davis	--------	--------	1	--------	--------	2	3
Jones	32	--------	14	2	--------	7	55
Lamar	2	2	1	--------	--------	5	10
Lincoln	10	--------	5	--------	--------	10	25
Madison	--------	--------	--------	--------	--------	3	3
Marion	6	10	5	--------	--------	3	24
Monroe	--------	--------	1	--------	--------	--------	1
Newton	--------	--------	--------	--------	--------	1	1
Oktibbeha	--------	--------	--------	--------	--------	1	1
Pearl River	5	8	3	--------	--------	7	23
Perry	--------	--------	--------	--------	--------	3	3
Pike	43	--------	27	1	--------	8	79
Rankin	4	--------	1	--------	--------	3	8
Scott	1	--------	--------	--------	--------	4	5
Sharkey	--------	--------	--------	--------	--------	1	1
Simpson	8	--------	3	--------	--------	2	13
Smith	3	--------	5	1	--------	11	20
Stone	--------	--------	--------	--------	--------	1	1
Tate	--------	--------	--------	--------	--------	1	1
Walthall	3	17	3	--------	--------	7	30
Wayne	4	--------	5	--------	--------	12	21
Wilkinson	1	--------	1	--------	--------	7	9
Yazoo	2	--------	3	--------	--------	6	11
Total: 1961	201	45	151	10	0	200	607
1960	281	38	109	20	3	249	700

[1] Includes condensate.

Source: Mississippi State Oil & Gas Bulletin, Jackson, Miss. v. 61, No. 1, March 1961, through No. 12, February 1962.

Ten new field discoveries were North Pellucid Bayou and Southeast Moss Hill in Adams County, Collins in Covington County, Morgans in Hinds County, Cannonsburg and Gilliam Chute in Jefferson County, Summerland and Pool Creek in Jones County, Lazy Creek in Pike County, and Traxler in Smith County.

TABLE 3.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1960	Changes in proved reserves, due to extensions and new discoveries in 1961	Proved reserves, Dec. 31, 1961 (production was deducted)	Change from 1960, percent
Crude oil……thousand barrels	407,098	47,457	401,170	−1
Natural gas liquids [1]……do	36,181	1,176	34,879	−4
Natural gas……million cubic feet	2,542,338	486,638	2,847,989	+12

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas. V. 16, Dec. 31, 1961, pp. 11, 12, 21.

According to the Mississippi State Oil and Gas Bulletin, as of December 31, 1961, the State had 220 oil pools and 47 gas pools producing in 194 fields; 3,343 wells, a net gain of 158 wells over 1960, were producing.

Natural Gas.—Marketed production of natural gas totaled 173 billion cubic feet valued at $32 million. Five counties—Adams, Forrest, Marion, Jefferson Davis, and Pearl River—supplied more than 76 percent of the State's production. During the year, 45 new gas wells were completed in producing fields. Rankin County reported new gas production.

Tennessee Gas Pipeline Co. awarded contracts for new compressor stations at Purvis and at De Kalb on its interstate pipeline system.

Natural Gas Liquids.—Natural gas liquids output increased 20 percent in volume and 10 percent in value over 1960. The average price per gallon decreased from 6.3 cents in 1960 to 5.7 cents in 1961; the difference between quantity and value increases for the year was attributed to this decline. About 35 percent of the gross production of natural gas was processed in the State's four natural gasoline and cycling plants—Brookhaven gas-cycling plant in Lincoln County, Cranfield gas-cycling operations in Adams County, and Little Creek and McComb processing plants in Pike County.

TABLE 4.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)	Year	Million cubic feet	Value (thousands)
1952–56 (average)	163,421	$13,685	1959	162,095	$25,125
1957	169,967	17,507	1960	172,478	32,426
1958	160,143	22,260	1961	172,543	32,093

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

TABLE 5.—Natural gas liquids production
(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	28,191	$2,034	15,113	$599	43,304	$2,633
1957	25,152	1,469	10,044	472	35,196	1,941
1958	25,738	1,658	9,208	503	34,946	2,161
1959	23,207	1,495	8,141	465	31,348	1,960
1960	23,648	1,552	10,151	564	33,799	2,116
1961	25,135	1,625	15,510	700	40,645	2,325

A manmade underground solution cavern in a Forrest County salt dome was utilized for storing propane, butane, and LP gases. Material stored as of October 1961 was as follows: Propane, 873,700 barrels; butane, 315,000 barrels; and LP gases, 1,848,000 barrels.

Petroleum.—The volume and value of crude oil production continued to increase, and reached 54 million barrels valued at $154 million, about 5 percent in both volume and value above the 1960 totals. Approximately 15 percent (14 percent in 1960) of the total crude petroleum produced was refined in the State's three plants: Southland Oils, Inc., at Rogers Lacy, Paluxy Asphalt Co. at Crupp Station, and Pontiac Eastern Corp. at Purvis. Cal-Ken Pipe Line Co. began constructing a 104-mile, 20-inch-diameter crude-oil line from Buras, La., to the site of a new refinery at Pascagoula.

Petrochemicals.—Coastal Chemical Co., Pascagoula, Jackson County; Mississippi Chemical Co., Yazoo City, Yazoo County; and Mississippi Federated Co-ops, Hattiesburg, Forrest County, announced substantial expansions to their fertilizer and chemical plants.

TABLE 6.—Crude petroleum production

(Thousand barrels and thousand dollars)

Year	Production	Value	Year	Production	Value
1952–56 (average)	36,947	$88,698	1959	49,620	$140,921
1957	38,922	113,263	1960	51,673	146,235
1958	39,512	113,004	1961 [1]	54,492	153,667

[1] Preliminary figures.

New petrochemical-using industries on which construction began in 1961 included a creosoting plant by Canton Treating Co. at Canton, Madison County; a plastics plant by General Tire and Rubber Co. at Columbus, Lowndes County; and a vinyl plastics plant by Southbridge Plastics Products at Corinth, Alcorn County.

TABLE 7.—Crude petroleum production, indicated demand, and stocks in 1961, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks originating in Mississippi
January	4,610	4,299	2,657
February	4,144	4,229	2,572
March	4,645	4,490	2,727
April	4,496	4,654	2,569
May	4,644	4,824	2,389
June	4,325	4,135	2,579
July	4,614	4,958	2,235
August	4,633	4,438	2,430
September	4,481	4,599	2,312
October	4,631	4,895	2,048
November	4,576	4,242	2,382
December	4,693	4,502	2,573
Total: 1961	[1] 54,492	54,265	-----
1960	51,673	51,687	-----

[1] Preliminary figure.

TABLE 8.—Crude petroleum production by fields [1]

(Thousand barrels)

Field	1957	1958	1959	1960	1961 [2]
Baxterville	4,939	4,993	5,843	5,877	5,949
Bolton	1,148	1,248	1,380	1,436	1,136
Brookhaven	2,541	2,218	1,920	1,758	1,571
Bryan	-----	-----	1,222	1,888	3,391
Church Hill	-----	-----	-----	532	460
Cranfield	1,206	982	840	733	901
Diamond	-----	959	1,040	1,154	924
Eucutta	1,318	1,611	1,559	1,386	1,261
Heidelberg	3,395	2,916	3,672	3,351	3,974
La Grange and South	1,936	1,649	1,714	1,453	1,471
Little Creek	-----	1,440	5,896	5,774	6,431
Mallalieu	841	739	744	593	562
Martinsville	-----	-----	-----	703	627
Maxie-Pistol Ridge	1,277	1,185	1,207	1,000	651
McComb	-----	-----	-----	2,533	2,949
Merit	-----	-----	-----	608	716
Overton and North	-----	-----	-----	459	621
Raleigh	-----	-----	2,168	2,157	1,820
Soso	4,241	4,174	4,651	3,901	3,418
Tinsley	3,884	3,830	3,532	3,347	2,991
Yellow Creek	1,323	1,054	1,020	1,170	1,222
Other fields [3]	10,873	10,514	11,212	9,860	11,446
Total	38,922	39,512	49,620	51,673	54,492

[1] Based on Oil and Gas Journal data adjusted to Bureau of Mines total.
[2] Preliminary figures.
[3] Bureau of Mines data.

NONMETALS

Cement.—Production of portland cement declined, and output of masonry cement increased during the year. Rebel Concrete Co. constructed a ready-mixed concrete and concrete products plant near Ridgeland, Madison County, to serve the Madison-Ridgeland area.

Clays.—Clay production was up 9 percent over 1960, establishing a new record for the second consecutive year. Increases were reported in quantities of ball clay, fire clay, fuller's earth, and miscellaneous clay sold or used.

Total tonnage of miscellaneous clay, used for manufacturing heavy clay products and lightweight aggregate, was about 59 percent of

TABLE 9.—Shipments of portland cement to Mississippi consumers

Year	Mississippi (thousand barrels)	Change, percent	
		Mississippi	United States
1952-56 (average)	1,803		
1957	2,188	+11	−6
1958	2,778	+27	+6
1959	3,072	+11	+9
1960	3,324	+8	−7
1961	3,603	+8	+3

the State's clay production. Bentonite production declined 4 percent below the 1960 total. Bentonite was used principally as a binder in foundry and steelworks moldmaking, as an absorbent, and as a filtering and decolorizing agent. Ball clay production, all from Panola County, increased 11 percent over 1960. The volume of fuller's earth, produced solely in Tippah County, gained 13 percent over 1960.

TABLE 10.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fire clay, and fuller's earth		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Qunatity	Value
1952-56 (average)	209	$2,144	75	$830	304	$315	588	$3,289
1957	220	2,372	101	968	295	295	616	3,635
1958	177	2,081	106	964	293	293	576	3,338
1959	200	2,494	117	1,138	430	432	747	4,064
1960	238	2,900	181	1,287	598	599	1,017	4,786
1961	228	2,836	226	1,547	650	651	1,104	5,034

In June, Delta Macon Brick and Tile Co. completed construction of a clay-products plant at Macon with a capacity of 60,000 face brick per day. Clay for the plant was mined at open pits near Golson, 10 miles west of Shuqualak.

Magnesium Compounds.—The H. K. Porter Co., Inc., plant at Pascagoula continued to produce magnesium compounds. Volume of production was slightly below 1960 output. Magnesium-bearing lime made from dolomite mined in Alabama was used in the process.

Potassium Compounds.—In December, Southwest Potash Co., Division of American Metal Climax, Inc., completed a $7 million plant at Vicksburg to produce potassium nitrate and chlorine.

Salt.—International Salt Co. announced plans to develop an underground salt mine in the Bruinsburg salt dome. The dome is in Claiborne County west of Port Gibson and near the Mississippi River. The mine was to be developed through a vertical shaft.

Sand and Gravel.—Sand and gravel output decreased 4 percent in tonnage and increased 6 percent in value as compared with 1960. Sand and gravel production was reported from 20 of the State's 82 counties. Leading counties in order of value were Copiah, Hinds, Adams, Lowndes, and Forrest. These five counties produced 62 percent of the tonnage and 59 percent of the value.

TABLE 11.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952-56 (average)	3,828	$3,253	438	$267	4,266	$3,520
1957	4,484	3,920	688	424	5,172	4,344
1958	5,614	5,149	931	1,091	6,545	6,240
1959	6,921	7,199	599	544	7,520	7,743
1960	6,068	5,522	113	46	6,181	5,568
1961	5,536	5,314	384	589	5,920	5,903

TABLE 12.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	814	$610	710	$590
Paving	1,268	938	999	890
Other [1]	75	138	58	129
Total	2,157	1,686	1,767	1,609
Gravel:				
Building	1,274	1,437	991	976
Paving	2,351	2,185	2,675	2,670
Other [2]	286	214	103	59
Total	3,911	3,836	3,769	3,705
Total sand and gravel	6,068	5,522	5,536	5,314
Government-and-contractor operations:				
Sand: Paving	30	9	184	195
Gravel: Paving	83	37	200	394
Total sand and gravel	113	46	384	589
Grand total	6,181	5,568	5,920	5,903

[1] Includes molding, engine, and other construction and industrial sand.
[2] Includes railroad ballast and miscellaneous gravel.

Stone.—Agricultural limestone was produced in Clay and Noxubee Counties by the Division of Lime, Mississippi Department of Agriculture, by two commercial producers in Smith County, and by one producer in Hinds County. Near Tishomingo, thin-bedded sandstone was quarried for veneer and wall construction on residences and other buildings. Oyster and clam shell, for use in manufacturing cement, lime, and chemicals, was dredged from Mississippi Sound off the shore of Harrison County. It was the first reported commercial production of shell from Mississippi.

Sulfur.—Production of recovered sulfur by Pontiac Eastern Corp., Lamar County, increased 11 percent in tonnage as compared with 1960. The sulfur was recovered from sour natural gas.

TABLE 13.—Sand and gravel production in 1961, by counties

(Short tons)

County	Quantity	Value
Bolivar	50,073	$65,270
Clay	112,200	84,151
De Soto	385,323	409,957
Forrest	620,000	465,000
Grenada	40,500	30,000
Harrison	27,000	25,000
Holmes	240,000	280,000
Jefferson Davis	352	141
Leflore	30,000	21,000
Lowndes	685,092	501,928
Monroe	331,470	224,692
Pearl River	13,500	16,050
Yazoo	106,713	42,685
Other counties [1]	3,277,346	3,737,400
Total	5,919,569	5,903,274

[1] Includes Adams, Copiah, Hinds, Panola, Perry, Tishomingo, and Yalobusha Counties, combined to avoid disclosing individual company confidential data.

METALS

Manganese.—American Potash and Chemical Corp. started constructing a $5 million electrolytic manganese plant adjacent to its sodium chlorate plant near Hamilton, Monroe County. The new plant was to process imported manganese ore. Initial annual capacity was to be 10 million pounds of manganese, from which several manganiferous products will be made. Completion was scheduled for early 1962.

Iron Ore.—Mississippi State Geological Survey undertook a survey of the State's iron ore resources. The work included geologic mapping mineralogic studies, and chemical analyses of samples obtained by core drilling. The project was to be completed in 1962.

REVIEW BY COUNTIES

Only counties with significant mineral production are discussed below; see table 14 for additional details.

Adams.—For the second consecutive year, Adams County led in total value of minerals produced and in natural gas and ranked third in petroleum, producing approximately 26 percent of the State's natural gas and 12 percent of the crude oil. With a total of 73 holes drilled, the county ranked second in drilling activity. Two new oilfields, North Pellucid Bayou and Southeast Moss Hill, were discovered as the result of exploratory drilling; development drilling added 18 oil wells to producing fields.

Alcorn.—Corinth Brick & Tile Co. mined clay near Corinth for manufacturing building brick and tile. Southbridge Plastic Products, Inc., announced plans to construct a vinyl plastic plant at Corinth; it expected to employ 400 workers.

Amite.—Development drilling during the year brought in 20 new productive wells.

Attala.—Kan-Kote, Inc., announced plans for an electroplating plant at Kosciusko. Fifteen or more workers were to be employed.

TABLE 14.—Value of mineral production in Mississippi, by counties[1]

County	1960[3]	1961	Minerals produced in 1961 in order of value
Adams	$28,078,309	$30,288,693	Petroleum, natural gas, lime, natural gas liquids, sand and gravel.
Alcorn	(2)	(2)	Clays.
Amite	633,156	2,776,574	Petroleum, natural gas.
Attala	3,375	(2)	Clays.
Bolivar	52,800	65,270	Sand and gravel.
Carroll	(2)	11,339	Clays.
Chickasaw	(2)	24,707	Natural gas, clays.
Clarke	1,045,428	1,153,515	Petroleum, natural gas.
Clay	171,899	463,508	Natural gas, sand and gravel, stone, petroleum.
Copiah	(2)	(2)	Sand and gravel.
De Soto	(2)	409,957	Do.
Forrest	10,326,027	9,799,721	Natural gas, petroleum, sand and gravel, clays.
Franklin	3,770,838	3,247,162	Petroleum, natural gas.
George	(2)	-----------	
Greene	5,067	2,438	Petroleum.
Grenada	(2)	30,000	Sand and gravel.
Hancock	462,258	804,965	Natural gas, petroleum.
Harrison	(2)	(2)	Shell, sand and gravel.
Hinds	5,090,243	4,495,149	Petroleum, sand and gravel, clays, natural gas, stone.
Holmes	(2)	280,000	Sand and gravel.
Itawamba	(2)	(2)	Clays.
Jackson	(2)	(2)	Lime, magnesium compounds.
Jasper	15,027,180	16,452,001	Petroleum, natural gas.
Jefferson	5,104,913	4,640,055	Do.
Jefferson Davis	3,901,732	3,629,270	Natural gas, petroleum, sand and gravel.
Jones	11,043,648	14,126,247	Petroleum, natural gas, clays.
Lamar	12,411,040	12,458,939	Petroleum, natural gas.
Lauderdale	(2)	10,000	Clays.
Lee	(2)	(2)	Do.
Leflore	(2)	21,000	Sand and gravel.
Lincoln	19,811,251	19,078,962	Petroleum, natural gas liquids, natural gas, clays.
Lowndes	(2)	523,790	Sand and gravel, clays.
Madison	793,657	703,073	Petroleum, natural gas.
Marion	3,227,570	5,729,962	Natural gas, petroleum.
Marshall	(2)	(2)	Clays.
Monroe	3,909,734	3,333,929	Clays, natural gas, sand and gravel, petroleum.
Noxubee	55,971	170,154	Clays, stone.
Panola	(2)	(2)	Clays, sand and gravel.
Pearl River	4,446,819	4,310,565	Natural gas, petroleum, sand and gravel, clays.
Perry	(2)	(2)	Sand and gravel, petroleum.
Pike	17,072,939	21,857,859	Petroleum, natural gas liquids, natural gas.
Pontotoc	(2)	10,150	Clays.
Prentiss	(2)	6,375	Do.
Rankin	4,373,072	4,377,409	Cement, stone, petroleum, natural gas.
Scott	75,235	58,166	Petroleum.
Sharkey	8,772	5,218	Do.
Simpson	5,259,563	5,504,046	Petroleum, natural gas.
Smith	10,567,784	9,702,436	Petroleum, clays, natural gas.
Stone	(2)	-----------	
Sunflower	5,599	9,674	Clays.
Tippah	(2)	(2)	Do.
Tishomingo	(2)	(2)	Sand and gravel, stone.
Walthall	1,674,847	2,127,588	Natural gas, petroleum.
Warren	(2)	(2)	Cement, stone.
Washington	(2)	-----------	
Wayne	9,763,287	9,629,150	Petroleum, natural gas.
Wilkinson	2,289,370	1,642,076	Do.
Yalobusha	(2)	(2)	Sand and gravel.
Yazoo	9,490,125	9,249,961	Petroleum, sand and gravel, natural gas.
Undistributed	8,495,280	7,020,947	
Total	198,449,000	210,242,000	

[1] The following counties were not listed because no production was reported: Benton, Calhoun, Choctaw, Claiborne, Coahoma, Covington, Humphreys, Issaquena, Kemper, Lafayette, Lawrence, Leake, Montgomery, Neshoba, Newton, Oktibbeha, Quitman, Tallahatchie, Tate, Tunica, Union, Webster, and Winston.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figures.

Chickasaw.—Gulf States Ceramic Corp. announced plans for a ceramics plant at Houston and was to employ about 60 persons.

Clarke.—Eleven new oil wells were added to producing fields by development drilling.

Clay.—Near Cedar Bluff, the Division of Lime, Mississippi Department of Agriculture, continued to produce agricultural limestone from open pits. West Point Gravel Co. produced washed sand and gravel for highway and building construction.

Copiah.—The county was an important producer of sand and gravel for highway and other construction, leading in the State in value and total tons produced.

Covington.—Exploratory drilling resulted in discovery of the Collins oilfield; subsequent development drilling brought in one new oil producer. This was the first discovery in the county.

De Soto.—Production of washed sand and gravel for highway and other construction continued. A large percentage of the material was used in Memphis, Tenn.

Forrest.—The county ranked second in natural gas production. Development drilling resulted in one oil well, four gas wells, and three dry holes. Washed sand and gravel was produced for highway and other construction. Clay for making face brick and structural tile was quarried by Hattiesburg Brick Works. Mississippi Federated Co-ops announced plans to build a fertilizer plant at Hattiesburg.

Franklin.—Development drilling resulted in 9 oil producers, 1 gas producer, and 9 dry holes; exploratory drilling resulted in 11 dry holes.

Hancock.—Two development wells were drilled; one produced oil, and one was dry. Exploratory drilling resulted in three dry holes. Industrial Electric, Inc., announced plans for a porcelain enamelware plant at Bay St. Louis. About 100 workers were to be employed at the new plant.

Harrison.—Oyster and clam shell for manufacturing lime and for other uses was dredged from Mississippi Sound. It was the first production of shell reported from the State.

Hinds.—Exploratory drilling resulted in discovery of Morgans oilfield and six dry holes. One productive development hole was drilled. The county led in the quantity of miscellaneous clay mined and used for manufacturing face brick and other clay products.

Jackson.—In October, Standard Oil Co. of Kentucky started constructing a $125 million oil refinery at Bayou Casotte, on the Gulf coast 4 miles southeast of Pascagoula. The new refinery was to have a daily capacity for treating 100,000 barrels of crude oil and was to employ about 700 persons. The plant was to have facilities for transporting products by pipeline and a deepwater channel to the Gulf of Mexico, and was scheduled to go on stream early in 1964. Other facilities included a 32,000-barrel-a-day catalytic-cracking unit, an 18,000-barrel-a-day isocracker, a 19-million-cubic-foot-a-day hydrogen-manufacturing unit, and a boiler plant. Mississippi Chemical Corp. announced a $4.5 million expansion of its Gulf coast plant at Pascagoula; capacity of its nitrogen fertilizer plant was to be doubled by adding 200 tons to daily production. A $6 million port development was authorized for Pascagoula and Gulfport by the Mississippi State Budget Commission.

The H. K. Porter Co., Inc., plant at Pascagoula, manufacturing magnesium compounds, reported making lime from dolomite produced in Alabama. It was the first time that lime production had been reported in Mississippi.

Jasper.—The county ranked fourth in the State as a petroleum producer. Of 15 development wells drilled, 10 were oil-producing, 1 was gas-producing, and 4 were dry. Six dry exploratory holes were drilled.

Jefferson.—Exploratory drilling resulted in discovery of the Cannonsburg and Gilliam Chute oilfields and five dry holes. Development drilling added five oil wells and one gas well to producing fields; nine holes were dry.

Jefferson Davis.—The county ranked fourth in gas production. One dry development hole and two dry exploratory holes were drilled.

Jones.—The county ranked fifth in both crude oil production and total mineral value. Development drilling added 32 oil wells to producing fields, and 2 new oilfields (Summerland and Pool Creek) were discovered in exploratory drilling. Laurel Brick and Tile Co., Inc., made face brick from miscellaneous clay mined from open pits.

Kemper.—Tennessee Gas Pipeline Co. awarded contracts for a compressor station at De Kalb on its interstate gasline system. This was one of two new stations being built in Mississippi.

Lamar.—Sulfur production by Pontiac Eastern Corp. was 11 percent above the 1960 output. Tennessee Gas Pipeline Co. awarded contracts for constructing a pipeline compressor station at Purvis.

Lincoln.—The county ranked second in value of crude oil and third in total value of minerals produced. Development drilling opened 10 new oil wells; 5 holes were dry. Ten exploratory holes were unproductive.

Madison.—Canton Treating Co. announced plans for a creosoting plant at Canton. Approximately 25 men were to be employed.

Marion.—Marion County ranked third in value of natural gas by producing approximately 10 percent of the State total. Development well drilling added 6 oil wells and 10 gas wells to proved fields. Exploratory drilling resulted in three dry holes.

Marshall.—Holly Springs Brick & Tile Co. and Southern Brick & Tile Co. mined fire clay and miscellaneous clay from open pits to make building brick.

Monroe.—The county retained its lead in value of clay production, accounting for 35 percent of the State total. Bentonite was mined from open pits and processed for moldmaking in foundries and steelworks, absorbing, filtering, and decolorizing.

American Potash and Chemical Corp. was constructing a plant near Hamilton to produce manganese from imported manganese ore. The plant, scheduled for completion early in 1962, was to have an initial capacity of 10 million pounds of manganese metal per year.

Noxubee.—Delta Macon Brick & Tile Co. completed a new 60,000-brick-per-day plant at Macon. Clay for the plant was obtained from pits near Shuqualak. Agricultural limestone was produced by the Division of Lime, Mississippi Department of Agriculture.

Panola.—Kentucky-Tennessee Clay Co. quarried ball clay for glass-refractory use. Washed sand and gravel was produced for highway and structural uses.

Pearl River.—The county ranked fifth in value of natural gas produced. Development drilling of 16 holes resulted in 5 oil producers, 8 gas producers, and 3 dry holes. Seven exploratory drill holes were dry.

Pike.—With a total of 79, Pike County led in the number of holes drilled. Exploratory drilling resulted in discovery of the Lazy Creek oilfield and eight dry holes. Forty-three of seventy development holes were productive. The county ranked second in total value of minerals and led in petroleum production, accounting for 13 percent of the State's oil. Croft Aluminum Co. announced plans to construct a plant at Osyka to produce aluminum doors and windows.

Pontotoc.—W. B. Ferguson and Pontotoc Brick Co. mined miscellaneous clay from open pits for manufacturing building brick.

Rankin.—Marquette Cement Manufacturing Co. produced portland and masonry cements at its plant in Brandon, one of the State's two cement plants. Development drilling resulted in four oil wells and one dry hole. Three exploratory holes were dry.

Scott.—The one development oil well drilled in the county during 1961 was productive, but four exploratory wells were dry.

Simpson.—Development drilling resulted in eight oil wells and three dry holes; two exploratory holes were dry.

Smith.—Exploratory drilling resulted in discovery of the Traxler oilfield; 11 holes were dry. Development drilling brought in three oil producers; five holes were dry.

Tippah.—Fuller's earth was mined from open pits. The county ranked second in the value of clay produced.

Tishomingo.—A natural mixture of sand and clay was mined for moldmaking in foundries and steelworks. Southward Stone Co. quarried thin-bedded sandstone slabs for construction purposes.

Walthall.—Development drilling added 3 oil wells and 17 gas wells to proved fields; 3 holes were dry. Seven dry exploratory holes were drilled.

Warren.—At Vicksburg, Southwest Potash Co., Division of American Metal Climax, Inc., completed construction of a plant to produce potassium nitrate and chlorine. Mississippi Valley Portland Cement Co. announced plans to double the capacity of its Redwood cement plant.

Wayne.—Twelve exploratory drill holes were unproductive; development drilling resulted in 4 oil producers and 5 dry holes.

Yazoo.—Mississippi Chemical Co., Yazoo City, announced plans to enlarge its fertilizer plant; 10 new employees were to be added to the labor force. Oil and gas continued to be the major contributor to the value of mineral production in the county.

The Mineral Industry of Missouri

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Division of Geological Survey and Water Resources, Department of Business Administration of Missouri.

By W. G. Diamond[1] and William C. Hayes[2]

◆

MINERAL production of Missouri in 1961 totaled $145 million, a 7-percent decrease from the 1960 value. Mineral output was reported from 102 of the 114 counties. Leading counties in order of production value were St. Louis, St. Francois, Cape Girardeau, Ste. Genevieve, and Jackson. Eighteen mineral commodities were produced in the State—seven metals, eight nonmetals, and three mineral fuels. The six principal commodities in order of value were cement, stone, lead, lime, coal, and sand and gravel. Nonmetals comprised 73 percent of the total value, metals 18 percent, and mineral fuels 9 percent. Missouri ranked first in lead production in the Nation for the 54th consecutive year.

Decreased lead production compounded by a lower unit value of lead, accounted for almost half the total decrease in mineral output value. Three lead mines were closed in 1961—Madison mine of National Lead Co. and Bonne Terre and National mines of St. Joseph Lead Co. Reduced activity in lead mining was reflected in the State's average annual employment for metal mining, which dropped 18 percent below the 1960 average.

In view of the prominent position of lead production in the State in the past and the possible effects on the industry of recent discoveries of substantial lead deposits and continued exploration for additional reserves, a study of the change in the status of the industry during the period 1951–61 was made. As a result, several pertinent facts were revealed.

Lead production supplied almost 32 percent of the total mineral production value in 1951, compared with 14 percent in 1961. Although lead production in Missouri dropped at an annual rate of 2.2 percent from 1951 through 1961, this was substantially less than the 3.9 percent average annual rate of decline for the Nation. The average annual decrease in value of lead production in the State from 1951 through 1961 was 7.2 percent. The average price of lead in 1951 was 17.3 cents per pound, compared with 10.3 cents per pound in 1961.

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TABLE 1.—Mineral production in Missouri[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite.....short tons..	180,702	$2,588	227,323	$3,052
Cement:				
Portland.....thousand 376-pound barrels..	11,856	40,915	11,839	41,142
Masonry.....thousand 280-pound barrels..	439	1,415	437	1,398
Clays.....thousand short tons..	2,540	7,207	2,132	5,040
Coal (bituminous).....do....	2,890	12,450	2,938	12,567
Copper (recoverable content of ores, etc.)..short tons..	1,087	698	1,479	887
Iron ore (usable).....thousand long tons, gross weight..	365	3,760	341	3,633
Lead (recoverable content of ores, etc.).....short tons..	111,948	26,196	98,785	20,350
Lime.....thousand short tons..	1,254	14,701	1,173	13,873
Natural gas.....million cubic feet	75	19	90	22
Petroleum (crude).....thousand 42-gallon barrels..	75	(2)	[3] 108	(2)
Sand and gravel.....thousand short tons..	10,207	11,601	9,371	10,688
Silver (recoverable content of ores, etc.). thousand troy ounces..	16	14	12	11
Stone.....thousand short tons..	27,180	37,878	25,631	36,577
Zinc (recoverable content of ores, etc.).....short tons..	2,821	728	5,847	1,345
Value of items that cannot be disclosed: Native asphalt, cobalt, gem stones, nickel, and values indicated by footnote 3.....	....	2,074	....	792
Total Missouri[4].....	....	[5] 156,041	....	145,365

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Preliminary figure.

[4] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

[5] Revised figure.

During 1961, continued development of lead and iron ore bodies, sustained intensive exploration activity, and passage of an amendment to the State constitution permitting municipalities to issue revenue bonds and general obligation bonds to construct industrial facilities indicated some favorable conditions for mineral industry growth in Missouri.

Development.—Meramec Mining Co., jointly owned by Bethlehem Steel Co. and St. Joseph Lead Co., continued development of the Pea Ridge iron ore body in Washington County. The mine service shaft and the main hoisting shaft had both reached 2,500 feet in depth. Work on office buildings and various other surface facilities was completed.

St. Joseph Lead Co. completed Shaft No. 28 of the Viburnum lead project, located at the mill site in Iron County. Surface construction at the site of Shaft No. 29 in Washington County was started in 1961.

Exploration.—Large-scale mineral exploration continued during 1961. Major companies conducting exploration projects included St. Joseph Lead Co.; National Lead Co.; American Zinc, Lead & Smelting Co.; American Smelting & Refining Co.; Bear Creek Mining Co. (subsidiary of Kennecott Copper Corp.); American Metal Climax, Inc.; Magnet Cove Barium Corp.; The Eagle-Picher Co.; Bethlehem Steel Co.; Granite City Steel Co.; Midwest Ore Co. (affiliate of Hanna Mining Co.); New Jersey Zinc Co.; Kerr-McGee Oil Industries, Inc.; Montana Phosphate Products; Missouri-Cliffs, Inc. (subsidiary of Cleveland-Cliffs Iron Co.); Sheffield Steel Division of ARMCO Steel Corp.; Phelps Dodge Corp.; and Homestake Mining Co.

The Eagle-Picher Co. obtained leases and started exploratory drilling in the Pierson Creek valley east of Springfield in Greene County. Small quantities of zinc and lead had been mined in this area in previous years.

Legislation.—On November 8, 1960, Missouri adopted an amendment to its constitution permitting communities to issue revenue bonds to finance industrial plant facilities and permitting all communities except those in Jackson and St. Louis Counties to issue general obligation bonds. Bonds may be issued to purchase, construct, extend, or improve plants, including real estate, buildings, fixtures, and machinery. The terms of this amendment included the financing of facilities for mineral-processing and mineral-consuming industries.

Employment and Injuries.—Average annual employment declined 18 percent in the metal-mining industry, 4 percent in the coal-mining industry, and 2 percent in the nonmetal-mining industry.

Five fatal accidents were reported by the lead- and zinc-mining industry. Two fatalities were caused by runaway mine trains, and three resulted from roof falls. One fatality was reported in a coal-mining-machinery accident.

TABLE 2.—Average annual employment of mining industries

Industry	1957	1958	1959	1960	[1] 1961
Metal mining	3,767	3,540	3,263	3,195	2,607
Nonmetal mining	4,030	3,941	4,286	3,820	3,759
Coal mining	970	800	856	864	828
Total	8,767	8,281	8,405	7,879	7,194

[1] Preliminary figure.

Source: Division of Employment Security, Department of Labor and Industrial Relations, State of Missouri.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Total value of nonmetals produced in 1961 was $106 million, $4 million less than in 1960. The only increases were in values of barite and cement.

Barite.—Shipments of barite from Washington County totaled 227,000 tons valued at $3.1 million—a 26-percent increase over the 1960 figure. Missouri ranked second in tonnage of barite mined and first in value of barite shipped.

Kagee Mining Co. began barite operations near Osage Beach in Miller County in August, but all production was stockpiled. Barite-grinding plants operated in Washington and St. Louis Counties. Principal consumers of Missouri barite were the oil-well-drilling and chemical industries.

Buckman Laboratories, Inc., began constructing a plant at Cadet, in Washington County, to produce barium borates and other barium compounds.

TABLE 3.—Barite sold or used by producers

Year	Short tons	Value	Year	Short tons	Value
1952–56 (average)	338,594	$3,554.285	1959	296,093	$3,923,651
1957	317,350	3,938,486	1960	180,702	2,587,820
1958	199,268	2,666,496	1961	227,323	3,051,663

Cement.—Portland cement production totaled 11.9 million barrels, 666,000 barrels less than in 1960. About 73 percent of the total annual capacity of the plants, in St. Louis, Cape Girardeau, Jackson, and Ralls Counties, was utilized during 1961. About 60 percent of the cement was manufactured by the wet-process method, and 40 percent by the dry-process method. The shipping pattern was altered noticeably after completion of additional facilities for truck shipment of bulk cement. Contributing to the change were Marquette Cement Manufacturing Co. with new bulk-loading facilities at its Cape Girardeau plant, and Missouri Portland Cement Co. with two new silos having bulk-loading facilities at its Prospect Hill plant at St. Louis. All cement plants reported truck shipments, both in bulk and in bags. Thirty-two percent of the total shipments in 1961, compared with 4 percent in 1960 and none in 1959 and 1958, were hauled by truck.

About 51 percent of the cement was shipped to consumers in 11 other States; the rest was used in Missouri.

Masonry cement was produced at all plants, with output about equal to that of 1960.

TABLE 4.—Portland cement production and shipments

(Thousand barrels and thousand dollars)

Year	Production	Shipments		Year	Production	Shipments	
		Quantity	Value			Quantity	Value
1952–56 (average)	11,187	11,119	$30,997	1959	13,610	13,583	$45,430
1957	10,866	10,794	34,307	1960	12,606	11,856	40,915
1958	12,143	11,813	39,376	1961	11,940	11,839	41,142

TABLE 5.—Shipments of portland cement to Missouri consumers

Year	Missouri (thousand barrels)	Change, percent		Year	Missouri (thousand barrels)	Change, percent	
		In Missouri	In United States			In Missouri	In United States
1952–56 (average)	7,250			1959	8,825	+16	+9
1957	6,851	−10	−6	1960	7,684	−13	−7
1958	7,636	+11	+6	1961	8,066	+5	+3

Clays.—Fire clay especially suitable for superduty refractory use comprised 52 percent of the tonnage and 80 percent of the value of clay production. Companies producing refractories were A. P. Green Fire Brick Co.; Kaiser Refractories and Chemicals Division, Kaiser Aluminum and Chemicals Corp.; Harbison-Walker Refractories Co.; Walsh Refractories Corp.; Refractories Division, H. K. Porter Co., Inc.; Wellsville Fire Brick Co.; General Refractories Co.; North American Refractories Co.; and Corhart Refractories Co., Inc. Fire clay for use in horizontal zinc retorts was mined in Monroe County by Gilliam Mining Co. and Fluetsch Bros.

Miscellaneous clay accounted for 48 percent of the clay tonnage and 20 percent of the value and was used in manufacturing heavy clay products and cement. Carter-Waters Corp. mined shale in Platte County for making lightweight aggregate.

TABLE 6.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Diaspore		Burley		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1952-56 (average)	1,496	$6,862	27	$422	42	$362	877	$1,166	2,442	$8,812
1957	1,672	6,206	10	123	50	398	916	921	2,648	7,648
1958	1,176	4,806	9	143	27	190	848	847	2,060	5,986
1959	1,623	5,630	6	93	28	197	978	978	2,635	6,898
1960	1,508	5,867	4	73	29	268	999	999	2,540	7,207
1961	[1] 1,096	3,901	8	64	8	55	1,020	1,020	2,132	5,040

[1] Includes ball clay.

Gem Stones.—Gem varieties of jasper, agate, galena, quartz, and barite were recovered.

Lime.—Production of lime declined for the second consecutive year; output decreased 7 percent in quantity and 6 percent in value compared with 1960. Lime was produced at six plants—two in Greene County and one each in Marion, Newton, St. Francois, and Ste. Genevieve Counties. Approximately 84 percent of the lime was used for chemical and industrial purposes, and 16 percent, for refractory and building uses. Nearly 82 percent of the total was quicklime, and 18 percent, hydrated lime.

TABLE 7.—Lime sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quicklime	Hydrated lime	Total lime	
			Quantity	Value
1952-56 (average)	1,074	209	1,283	$12,960
1957	1,172	221	1,393	16,475
1958	953	220	1,173	14,136
1959	1,089	235	1,324	15,714
1960	1,030	224	1,254	14,701
1961	958	215	1,173	13,873

Perlite.—Crude perlite, mined in Western States, was expanded by J. J. Brouk & Co. at its plant in St. Louis. Principal use was for lightweight aggregate.

Sand and Gravel.—Sand and gravel production was reported from 63 counties. Commercial operations furnished 93 percent of total tonnage and 96 percent of total value; the remainder was Government-

and-contractor output. Industrial sand, produced in Franklin, Jasper, Jefferson, St. Charles, and St. Louis Counties, comprised 8 percent of total tonnage and 26 percent of total value. Approximately 86 percent of total production was used for building and highway construction; almost 97 percent was washed. Shipments of commercial sand and gravel were 72 percent by truck, 26 percent by rail, and 2 percent by other means.

Stone.—Limestone, granite, marble, sandstone, and miscellaneous stone were quarried. Stone production was reported from 78 counties. Limestone was quarried in 76 counties at 212 operations and supplied 97 percent of total tonnage and 92 percent of total value. Dimension marble was quarried in Jasper, Greene, and Ste. Genevieve Counties; marble was mined and crushed in Jasper, Jefferson, and Madison Counties. Miscellaneous stone (chats) was produced in Jasper and St. Francois Counties. Dimension and crushed granite was produced in Iron County. Sandstone was quarried in Shannon and Vernon Counties. Crushed stone was used mainly for concrete aggregate, roadstone, riprap, and agricultural stone; dimension stone was used as monumental and building stone. Over 96 percent of total stone output was by commercial producers.

TABLE 8.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952-56 (average)	7,193	$7,482	1,216	$850	8,409	$8,332
1957	7,198	8,000	1,282	942	8,480	8,942
1958	8,281	9,285	691	443	8,972	9,728
1959	9,573	10,959	706	447	10,279	11,406
1960	9,631	11,194	576	407	10,207	11,601
1961	8,744	10,266	627	422	9,371	10,688

TABLE 9.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,262	$2,743	3,062	$2,737
Paving	1,463	1,322	1,040	916
Fill	286	241	305	249
Industrial glass	422	1,093	386	1,017
Other [1]	466	1,629	459	1,751
Total	5,899	7,028	5,252	6,670
Gravel:				
Building	2,044	2,526	1,957	2,430
Paving	1,480	1,516	1,405	1,078
Fill	61	34	40	27
Other [2]	147	90	90	61
Total	3,732	4,166	3,492	3,596
Total sand and gravel	9,631	11,194	8,744	10,266
Government-and-contractor operations:				
Sand: Paving	15	15	25	25
Gravel: Paving	561	392	602	397
Total sand and gravel	576	407	627	422
Grand total	10,207	11,601	9,371	10,688

[1] Includes molding, filtering, railroad ballast, and other construction, industrial, and ground sand.
[2] Includes railroad ballast and miscellaneous gravel.

TABLE 10.—Sand and gravel production in 1961, by counties

County	Short tons	Value
Barry	22, 401	$14, 526
Bates	7, 020	2, 808
Boone	21, 000	17, 850
Buchanan	137, 020	137, 462
Butler	57, 741	36, 526
Callaway	19, 049	13, 015
Camden	24, 053	15, 462
Cole	248, 113	242, 268
Crawford	13, 772	7, 870
Dallas	8, 698	5, 591
Daviess	21, 500	21, 500
Dent	11, 900	6, 575
Douglas	213, 920	126, 778
Franklin	503, 177	552, 884
Greene	675	750
Howard	55, 703	47, 348
Howell	7, 778	4, 270
Jasper	129, 198	400, 323
Jefferson	407, 908	859, 046
Laclede	19, 234	19, 606
Lafayette	106, 321	105, 294
Lawrence	10, 465	6, 430
Lincoln	39, 530	26, 943
Maries	4, 589	2, 950
McDonald	3, 651	2, 086
Miller	101, 089	79, 221
Moniteau	23, 167	14, 893
Montgomery	72, 278	64, 581
Morgan	21, 963	14, 119
Nodaway	13, 800	18, 595
Oregon	4, 423	2, 527
Osage	6, 280	5, 118
Pemiscot	203, 500	203, 500
Perry	81, 182	60, 135
Phelps	14, 246	12, 216
Pike	8, 403	5, 702
Polk	13, 285	14, 205
Pulaski	109, 950	203, 553
Reynolds	5, 600	3, 200
St. Clair	1, 660	1, 067
St. Louis	4, 138, 904	4, 908, 984
Ste. Genevieve	11, 658	8, 216
Scott	640	640
Shannon	4, 305	2, 460
Stoddard	256, 096	247, 429
Stone	4, 120	2, 354
Texas	18, 388	10, 280
Vernon	4, 388	1, 755
Warren	15, 120	10, 335
Webster	7, 252	4, 144
Wright	2, 240	1, 280
Other counties [1]	2. 132. 688	2, 111, 545
Total	9, 371, 041	10, 688, 215

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[1] Includes Benton, Cape Girardeau, Cooper, Dunklin, Gentry, Jackson, Lewis, Livingston, Ralls, St. Charles, Washington, and Wayne Counties, combined to avoid disclosing individual company confidential data.

TABLE 11.—Stone sold or used by producers, by kinds

Year	Granite		Marble		Limestone		Sandstone		Miscellaneous stone [2]		Total stone	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1957	5,369	$232	(1)	(1)	20,936,499	$27,269	(1)	(1)	1,117,339	$751	22,097,639	$29,836
1958	3,648	260	(1)	(1)	23,387,507	30,774	(1)	(1)	870,879	465	24,275,550	32,878
1959	3,111	276	181,070	$1,704	25,980,397	33,944	5,209	$83	769,553	428	26,939,340	36,435
1960	3,806	233	148,930	1,737	26,410,534	35,475	2,811	42	614,287	391	27,180,368	37,878
1961	4,532	295	139,477	2,125	24,852,463	33,716	2,948	42	631,250	399	25,630,670	36,577

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Total stone."
[2] Chats; also includes small quantity of other stone.

At its Barton County pit, Bar-Co Roc Asphalt Co. produced asphaltic sandstone for road surfacing.

Roofing Granules.—Ruberoid Co. announced plans for a major expansion of its roofing granules operations with the purchase of property south of Annapolis in Iron County. Engineering studies were made for constructing complete facilities for mining, milling, coloring, and storing granules. Roofing granules produced were to be used by Ruberoid's plants in the Midwest and Southwest.

Tripoli.—The American Tripoli Division of the Carborundum Co. processed tripoli from Oklahoma at its Seneca plant in Newton County. Production was less than in 1960.

Vermiculite.—Crude vermiculite from Western States was exfoliated at plants in St. Louis and Jackson Counties.

METALS

Value of metals recovered in 1961 was $26.7 million, compared with $33.2 million in 1960. Value of all metals except copper and zinc was less than in 1960.

Mine Mills and Smelters.—Mine mills were operated in Madison, Washington, St. Francois, and Iron Counties. National Lead Co. ceased operating its Madison mill in January and the Government-owned cobalt-nickel refinery in March. St. Joseph Lead Co. operated its Indian Creek mill in Washington County, its Viburnum mill in Iron County, and its Bonne Terre, Leadwood, and Federal mills in St. Francois County. The Bonne Terre mill, however, was permanently closed in September. According to the company's 1961 annual report, conversion of the Federal mill to all-flotation, with a special circuit producing copper concentrate, was completed. The Herculaneum lead smelter operated three furnaces through April and two furnaces for the remainder of the year.

Cobalt and Nickel.—Cobalt and nickel were recovered from complex lead-copper-cobalt-nickel ores in Madison County. National Lead Co. ceased operating the Government-owned cobalt-nickel refinery when the cobalt purchase contract was completed. The refinery later was sold to a salvage firm.

Columbium-Tantalum.—Mallinckrodt Nuclear Corp., a subsidiary of Mallinckrodt Chemical Works produced potassium tantalum fluoride from imported ores.

Copper.—A small quantity of copper was recovered from lead ore and lead-copper ore mined in the lead belt. Compared with the 1960 figures, copper recovery increased.

Iron Ore.—Development of the Pea Ridge iron ore body was continued by Meramec Mining Co., owned jointly by Bethlehem Steel Co. and St. Joseph Lead Co. The mine service shaft was completed at a depth of 2,505 feet, and the main hoisting shaft was stopped at a depth of 2,491 feet where the first mining lift was to be established. The change house, hoist building, office buildings, ore bins, and service elevator were completed. Exploratory drifting and underground diamond core drilling to delineate the ore body continued.

Joint exploration in the Bourbon area by American Zinc, Lead and Smelting Co. and Granite City Steel continued. Development drilling by churn and diamond drills resulted in increased indicated and proved reserves. Engineering studies of mining costs and capital costs were being made.

Brown ore (limonite) and hematite ore were produced from 10 mines in 7 counties; reported average iron content of concentrates produced from the ores was 53 percent. Output declined 7 percent in tonnage and 3 percent in value, compared with the 1960 figures.

Iron and Steel.—Armco Steel Corp. reported installation of a fully automated bar joist plant and a third electric furnace at its Sheffield Division plant in Kansas City.

Iron and steel foundries, principally in the St. Louis and Kansas City areas, consumed iron and steel scrap and pig iron in producing iron and steel castings.

TABLE 12.—Ferrous scrap and pig iron consumption

(Short tons)

Year	Ferrous scrap	Pig iron	Total scrap and pig iron
1957	976, 266	51, 932	1, 028, 198
1958	896, 231	36, 257	932, 488
1959	843, 155	73, 518	916, 673
1960	827, 811	44, 649	872, 460
1961	869, 002	24, 246	893, 248

Lead.—Mine production of recoverable lead was 12 percent lower than in 1960. Total value of production declined 22 percent, as the price of lead (New York) was 11 cents per pound from January 1 through October 31, 10½ cents from November 1 through November 12, 10 cents from November 13 through November 27, and 10¼ cents from November 28 through December 31.

National Lead closed its Madison mine at Fredericktown on January 31; St. Joseph Lead Co. closed its Bonne Terre mine in August and its National mine in October. Reasons given for closing the mines included depressed metal prices, low grade of remaining ores, and depletion of the ore bodies.

TABLE 13.—Mine production of silver, copper, lead, and zinc, in terms of recoverable metals

Year	Mines producing	Material sold or treated		Silver		Copper		Lead		Zinc		Total value (thousands)
		Crude ore (short tons)	Old tailing (short tons)	Troy ounces	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)		6,826,423	1,516.549	358,783	$325	2,097	$1,327	125,917	$37,032	7,607	$2,073	$40,757
1957 / 57	16	6,874,008	1,271,684	183,427	166	1,604	966	126,345	36,135	2,951	684	37,951
1958	9	5,945,836	479,916	250,917	227	1.429	752	113,123	26,471	362	74	27,524
1959	4	5,573,517		339,760	308	1,065	654	105,165	24,188	92	21	25,171
1960	5	5,897,813		15,594	14	1,087	698	111,948	26,196	2,821	728	27,636
1961	7	5,242,779		11,793	11	1,479	887	98,785	20,350	5,847	1,345	22,593

TABLE 14.—Mine production of silver, copper, lead, and inc in 1961, by classes of ore or other source material, in terms of recoverable metals

Source	Number of mines	Material sold or treated (short tons)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lead ore [1]	7	5,242,779	11,793	1,479	98,785	5,847

[1] Includes lead-copper ore from 2 mines and a small quantity of zinc ore.

TABLE 15.—Mine production of lead and zinc in southeastern and central Missouri, in terms of concentrates and recoverable metals [1]

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Recoverable metal content [2]			
					Lead		Zinc	
	Short tons	Value [3] (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1952–56 (average)	179,469	$31,065	6,226	$542	124,428	$36,562	3.500	$917
1957	179,312	31,507	5,903	448	126,323	36,128	2,866	665
1958	159,068	23,015	770	41	113,123	26,471	362	74
1959	146,765	21,698	206	12	105,165	24,188	92	21
1960	155,781	23,105	5,602	446	111,948	26,196	2,821	728
1961	137,862	18,720	11,024	973	98,785	20,350	5,847	1,345

[1] Based on southeastern and central Missouri ore "dirt" and old tailing treated at mills.

[2] In calculating metal content of ores from assays, allowance has been made for smelting losses. In comparing values of concentrate "ore" and metal, value for concentrate is that received by producer, whereas value of lead and zinc is calculated from average price for all grades.

[3] Values are arbitrary, because part of lead concentrate is smelted by producer.

TABLE 16.—Tenor of lead and zinc ore, old tailing, and slimes milled and concentrate produced in southeastern Missouri

	Southeastern Missouri	
	1960	1961
Concentrate production:		
Lead ... short tons	155,781	137,862
Zinc ... do	5,602	11,024
Concentrate obtained from—		
Lead ... percent	2.64	2.63
Zinc ... do	0.094	0.21
Metal content of ore:[1]		
Lead ... do	1.90	1.88
Zinc ... do	0.05	0.11
Average lead content of galena concentrate ... do	73.33	73.12
Average zinc content of sphalerite concentrate ... do	55.94	58.94
Average value per ton:		
Galena concentrate	$148.31	$135.79
Sphalerite concentrate	79.61	88.24
Total material milled ... short tons	5,897,813	5,242,779

[1] Figures represent metal content of crude ore only as recovered in the concentrate; data on tailing losses not available.

TABLE 17.—Mine production of silver, copper, lead, and zinc in 1961 by months, in terms of recoverable metals

Month	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January		108	9,096	368
February		116	8,001	432
March		139	9,553	656
April		118	7,964	581
May		106	8,571	611
June		103	8,482	529
July		91	7,681	429
August		98	8,596	522
September		88	7,515	401
October	3,931	99	8,302	354
November	3,931	186	7,872	429
December	3,931	167	7,152	535
Total:				
1961	11,793	1,479	98,785	5,847
1960	15,594	1,087	111,948	2,821

TABLE 18.—Quoted prices of 60-percent zinc concentrate and 80-percent lead concentrate at Joplin, Mo., in 1961

Zinc concentrate		Lead concentrate	
Period	Price per short ton	Period	Price per short ton
Jan. 1-Jan. 8	$72.00	Jan. 1-Nov. 5	$125.16
Jan. 9-Dec. 3	68.00	Nov. 6-Nov. 12	117.96
Dec. 4-Dec. 31	72.00	Nov. 13-Nov. 23[1]	110.76

[1] Lead quotation discontinued.

Source: E&MJ Metal and Mineral Markets.

St. Joseph Lead Co. announced completion of Shaft No. 28 at the Viburnum mill site in Iron County at yearend. All 1961 output was hoisted through Shaft No. 27 in Crawford County. The company reported plans to complete Shaft No. 29 in Washington County and increase the daily capacity of the mill from 3,000 tons to 6,000 tons by 1963.

Silicon.—Ultrapure silicon metal for electronic use was produced by Monsanto Chemical Co. at its plant near St. Charles in St. Charles County, and by Mallinckrodt Chemical Works in St. Louis.

Silver.—Silver was recovered from lead and lead-copper ores mined in the lead belt of southeast Missouri.

Uranium.—Mallinckrodt Nuclear Corp. received an order to supply over 300 pounds of 20-percent enriched uranium for a reactor for Arbeitsgemeinschaft Versuchsreaktor in Düsseldorf, Germany. The fuel was made available under a bilateral agreement between the United States and West Germany.

Zinc.—Zinc was recovered from ores mined in St. Francois and Washington Counties. Output in 1961 was the largest since 1953. The price of Prime Western slab zinc was 12 cents per pound (East St. Louis) on January 1, dropped to 11½ cents January 10, and returned to 12 cents on December 1 where it remained to yearend.

For the fourth consecutive year, no zinc was produced in the southwestern Missouri part of the Tri-State district; hence the table "Mine production of lead and zinc in southwestern Missouri, in terms of concentrate and recoverable metals" has been deleted. Details of Tri-State activity are given in the Oklahoma chapter.

MINERAL FUELS

Coal (Bituminous).—Output of bituminous coal was slightly greater than in 1960. Nine underground mines in four counties supplied 2 percent of the State total coal tonnage and 3 percent of its total value. All underground production was cut by machines; 87 percent was power-drilled. Strip-mine production, reported from 19 mines in 11 counties, supplied 98 percent of tonnage and 97 percent of the value. Overburden excavated totaled over 52 million cubic yards and averaged nearly 21 cubic yards for each ton of coal produced by strip mines. Over 65 percent of the 2.9 million tons of coal mined was mechanically cleaned at 7 mines, nearly 42 percent was crushed at 10 mines, and nearly 3 percent was oil-treated at 6 mines.

Natural Gas.—Natural gas was produced from the Turney pool in Clinton County.

Petroleum.—A corporate reorganization placed American Oil Co. (Amoco) in charge of the Sugar Creek refinery formerly operated by Standard Oil Co. (Ind.). Amoco began constructing a 70,000-barrel-per-day crude-oil-distillation unit to replace four crude-distillation units.

Petroleum exploration consisted of 21 dry holes that totaled nearly 33,000 feet drilled, reported from Atchison, Bates, Cass, Clark, Knox, Lafayette, Lewis, Nodaway, Shelby, and Stoddard Counties.

Crude petroleum was produced near St. Louis and near Tarkio in Atchison County.

TABLE 19.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952-56 (average)	2,875	$11,584	1959	2,748	$11,937
1957	2,976	12,691	1960	2,890	12,450
1958	2,592	11,111	1961	2,938	12,567

REVIEW BY COUNTIES

Mineral production was reported in 102 of Missouri's 114 counties; 22 counties reported production valued at $1 million or more. Five counties—St. Louis, St. Francois, Cape Girardeau, Ste. Genevieve, and Jackson—accounted for 58 percent of the mineral production value. No mineral output was reported in Bollinger, Carroll, Carter, Chariton, Christian, Hickory, Holt, Mississippi, New Madrid, Ripley, Schuyler, and Scotland Counties. Only those counties with significant production are discussed below; see table 20 for additional details.

Adair.—Billy Creek Coal Co. and Blacksmith Coal Co., Inc., mined coal underground. Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by Rash Rock & Limestone Co. and Bailey Limestone Co., Inc.

Andrew.—Limestone was quarried and crushed by George W. Kerford Quarry Co. and the U.S. Army Corps of Engineers and used as riprap on the banks of the Missouri River.

Atchison.—Petroleum was produced near Tarkio.

TABLE 20.—Value of mineral production in Missouri, by counties [1]

County	1960	1961	Minerals produced in 1961 in order of value
Adair	$296,951	$273,971	Coal, stone.
Andrew	95,708	213,501	Stone.
Atchison	(2)	(2)	Petroleum.
Audrain	1,167,180	1,051,308	Clays, stone.
Barry	31,000	50,526	Stone, sand and gravel.
Barton	(2)	(2)	Coal, stone, asphaltic sandstone.
Bates	172,009	(2)	Stone, sand and gravel.
Benton	(2)	(2)	Sand and gravel, gem stones.
Bollinger	(2)	------------	
Boone	710,459	888,001	Stone, clays, sand and gravel.
Buchanan	375,160	280,435	Stone, sand and gravel.
Butler	92,084	37,249	Sand and gravel, clays.
Caldwell	297,673	187,881	Stone.
Callaway	1,980,431	1,530,361	Coal, stone, clays, sand and gravel.
Camden	(2)	(2)	Sand and gravel.
Cape Girardeau	11,676,509	12,074,327	Cement, stone, clays, sand and gravel.
Carter	(2)	------------	
Cass	383,470	254,017	Stone, clays.
Cedar	(2)	56,245	Stone.
Christian	(2)	------------	
Clark	413,180	344,275	Stone, coal.
Clay	2,036,751	1,130,921	Stone.
Clinton	180,848	122,666	Stone, natural gas.
Cole	270,219	286,539	Sand and gravel, stone, iron ore.
Cooper	584,076	292,820	Stone, sand and gravel.
Crawford	1,249,488	3,423,144	Lead, sand and gravel.
Dade	187,760	166,617	Stone, coal.
Dallas	(2)	5,591	Sand and gravel.
Daviess	(2)	207,875	Stone, sand and gravel.
De Kalb	144,190	166,153	Stone.
Dent	(2)	6,575	Sand and gravel.
Douglas	65,125	126,778	Do.
Dunklin	(2)	(2)	Do.

See footnotes at end of table.

TABLE 20.—Value of mineral production in Missouri, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Franklin	$1,150,347	$1,152,826	Sand and gravel, stone, clays.
Gasconade	2,347,439	1,248,350	Clays, stone.
Gentry	(2)	(2)	Stone, sand and gravel.
Greene	2,636,417	3,202,016	Stone, lime, sand and gravel
Grundy	(2)	(2)	Stone.
Harrison	359,119	159,900	Do.
Henry	6,346,958	5,269,427	Coal, stone
Hickory	(2)	------	
Howard	229,558	51,138	Sand and gravel, stone.
Howell	326,606	299,907	Iron ore, sand and gravel.
Iron	277,944	543,161	Stone, lead.
Jackson	11,328,133	9,950,044	Cement, stone, sand and gravel, clays.
Jasper	2,300,882	2,983,854	Stone, sand and gravel.
Jefferson	1,532,955	1,226,680	Sand and gravel, stone.
Johnson	147,768	582,637	Stone.
Knox	(2)	(2)	Do.
Laclede	(2)	19,606	Sand and gravel.
Lafayette	356,561	324,560	Stone, sand and gravel, coal.
Lawrence	5,500	253,691	Stone, sand and gravel.
Lewis	(2)	(2)	Do.
Lincoln	85,945	114,354	Do.
Linn	(2)	159,313	Stone.
Livingston	399,978	297,503	Stone, sand and gravel, clays.
Macon	(2)	(2)	Coal.
Madison	4,152,337	726,065	Cobalt, nickel, lead, stone, copper, silver.
Maries	277,778	100,456	Clays, stone, sand and gravel.
Marion	(2)	(2)	Stone, lime.
McDonald	(2)	2,086	Sand and gravel.
Mercer	(2)	(2)	Stone.
Miller	103,371	111,890	Sand and gravel, stone.
Moniteau	73,263	84,633	Stone, sand and gravel.
Monroe	343,616	268,509	Clays, stone.
Montgomery	766,958	597,608	Clays, stone, sand and gravel.
Morgan	28,686	16,951	Sand and gravel, stone.
Newton	425,316	353,433	Lime, stone.
Nodaway	197,221	(2)	Stone, sand and gravel.
Oregon	195,726	277,141	Iron ore, stone, sand and gravel.
Osage	408,571	(2)	Clays, sand and gravel.
Ozark	(2)	76,973	Iron ore.
Pemiscot	190,000	203,500	Sand and gravel.
Perry	133,352	112,667	Sand and gravel, stone.
Pettis	(2)	(2)	Stone.
Phelps	328,883	201,717	Clays, stone, sand and gravel.
Pike	311,571	318,461	Stone, sand and gravel.
Platte	504,620	(2)	Clays, stone.
Polk	(2)	14,205	Sand and gravel.
Pulaski	(2)	203,553	Do.
Putnam	(2)	(2)	Coal.
Ralls	5,764,215	5,640,458	Cement, stone, clays, sand and gravel, coal.
Randolph	3,005,100	2,447,940	Coal, stone.
Ray	(2)	(2)	Stone.
Reynolds	(2)	3,200	Sand and gravel.
Ripley	45,261	------	
St. Charles	1,170,713	1,112,055	Stone, sand and gravel.
St. Clair	(2)	(2)	Coal, stone, sand and gravel
St. Francois	25,823,104	20,261,983	Lead, iron ore, lime, zinc, stone.
Ste. Genevieve	12,900,372	12,001,428	Lime, stone, sand and gravel.
St. Louis	29,052,925	30,580,614	Cement, stone, sand and gravel, clays.
Saline	484,450	543,310	Stone.
Scott	------	42,640	Stone, sand and gravel.
Shannon	393,428	237,660	Iron ore, stone, sand and gravel.
Shelby	(2)	184,507	Stone.
Stoddard	226,700	247,429	Sand and gravel.
Stone	(2)	2,354	Do.
Sullivan	(2)	(2)	Stone.
Taney	(2)	(2)	Do.
Texas	39,507	37,291	Stone, sand and gravel.
Vernon	277,691	195,067	Coal, stone, sand and gravel.
Warren	298,934	239,696	Clays, stone, sand and gravel.
Washington	6,171,183	6,981,014	Barite, lead, copper, zinc, sand and gravel, silver.
Wayne	82,238	103,841	Sand and gravel, stone, iron ore.
Webster	------	4,144	Sand and gravel.
Worth	(2)	57,137	Stone.
Wright	63,633	64,042	Stone, sand and gravel.
Undistributed	9,557,972	9,690,599	
Total	[3] 156,041,000	145,365,000	

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[1] Counties not listed because no production was reported in 1960 or 1961: Carroll, Chariton, Holt, Mississippi, New Madrid, Schuyler, and Scotland.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Audrain.—The county ranked second in clay production for the seventh consecutive year. Fire clay for refractories was mined by or for Kaiser Refractories & Chemicals Division, Kaiser Aluminum & Chemical Corp.; A. P. Green Fire Brick Co.; Walsh Refractories Corp.; Wellsville Fire Brick Co.; North American Refractories Co.; and Refractories Division, H. K. Porter Co., Inc. Molino Lime Co. quarried and crushed limestone for concrete aggregate, roadstone, and agstone.

Barry.—Douthitt Lime Co. produced crushed limestone for concrete aggregate, roadstone, and agstone. The Missouri State Highway Department contracted for paving gravel.

Barton.—Coal was strip-mined by The Clemens Coal Co. and Jones Coal Co. Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by John J. Stark. Asphaltic sandstone for use on roads was produced by Bar-Co Roc Asphalt Co.

Bates.—Alvis Limestone & Concrete Products, Inc., and Frank Underwood quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. Clyde S. Miller obtained building gravel from local deposits.

Benton.—Gravel for paving was obtained locally by J. C. Orender and the Missouri State Highway Department. Gem varieties of jasper and other gem stones were found in the county.

Boone.—N. R. Garrett, Adrian Materials Co., Boone Quarries, Inc., Central Stone Co., and the U.S. Army Corps of Engineers quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. Shale and fire clay were mined and used by Columbia Brick & Tile Co. to manufacture heavy clay products. Columbia Sand Co. produced building gravel. Peabody Coal Co. began developing its Mark Twain coal mine; initial production was expected late in 1962.

Buchanan.—Building, paving, railroad ballast, and fill sand were produced by Pioneer Sand Co. Limestone for concrete aggregate, roadstone, agstone, and riprap was quarried and crushed by Everett Quarries, Inc., and L. S. Stafford.

Butler.—Sand and gravel was obtained by Grobe & Son, George Golden, Smittle Gravel Co., and the Missouri State Highway Department for building, paving, and other uses. Ozark Development Co. and A. D. Willis & Son Industries mined clay for pottery, stoneware, and heavy clay products.

Caldwell.—Farmers Rock & Lime, Inc., Kingston Stone Co., and Everett Quarries, Inc., quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap.

Callaway.—Callaway County ranked third in clay output and sixth in coal production. Fire clay for refractories was used by Harbison-Walker Refractories Co.; Kaiser Refractories & Chemicals Division; Walsh Refractories Corp.; Refractories Division, H. K. Porter Co., Inc.; and Clayton & Crowson. Limestone for concrete aggregate, roadstone, agstone, railroad ballast, and riprap was quarried and crushed by Auxvasse Stone & Gravel Co., Sulgrove Mining & Quarry Co., and Mo-Con, Inc., of Fulton. The Missouri State Highway Department contracted for paving gravel. Coal was strip-mined by Marriott-Reed Coal Co.

Cape Girardeau.—The county ranked second in cement production, sixth in stone output, and third in total value of mineral production. Marquette Cement Manufacturing Co. quarried clay and limestone for portland and masonry cements. Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by The Federal Materials Co., Inc., Farmers Limestone Co., and Jackson Limestone Quarry. Common red clay for brick, pottery, and stoneware was mined by Kasten Clay Products, Inc., and Ceramo Co., Inc. Building sand was produced by Cape Girardeau Sand Co.

Cass.—Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Hackler & Limpus Quarry, Marino & Hoover Crushed Rock Co., Emmet Brosnahan Rock Co., Deitz Hill Development Co., and S & W Quarries. Miscellaneous clay for brick and tile manufacture was mined by United Brick & Tile Co.

Cedar.—Geo. M. Baker Co. produced crushed limestone from quarries near Caplinger Mills and Jerico Springs for use as concrete aggregate, roadstone, agstone, and riprap.

Clark.—Baker Quarry Co. and Brooks Quarry, Inc., quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. Hamlin Bros. Coal Co. strip-mined coal.

Clay.—Clay County ranked seventh in value of stone production. Midwest PreCote Co., Kansas City Quarries Co., J. H. Oldham Stone Co., Everett Quarries, Inc., and the Clay County Highway Department quarried and crushed limestone for concrete aggregate, roadstone, riprap, asphalt filler, and agstone.

Clinton.—Everett Quarries, Inc., quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. Natural gas was produced from the Turney pool.

Cole.—Leonard Barnhart, Jefferson City Sand Co., the Cole County Highway Department, and the Missouri State Highway Department obtained sand and gravel along the Osage and Missouri Rivers. The U.S. Army Corps of Engineers produced crushed limestone for use as riprap. A small quantity of brown iron ore (limonite) was mined.

Cooper.—Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by Hall & Riley Quarries & Construction Co., Castle Bros. Quarry Co., and the U.S. Army Corps of Engineers. Building sand and paving gravel was produced by Missouri River Sand & Gravel Co.

Crawford.—St. Joseph Lead Co. mined lead ore through Shaft No. 27 of its Viburnum operation; the ore was milled in Iron County. The county ranked second in output of lead. The Missouri State Highway Department contracted for paving gravel.

Dade.—Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Lockwood Rock Products. Coal was strip-mined by Tyler & Claypool Coal Co.

Daviess.—Snyder Quarries, Inc., quarried and crushed limestone for concrete aggregate, roadstone, and agstone. Bethany Falls Transit Mixed Concrete Co. furnished sand for building, paving, and fill uses.

De Kalb.—Everett Quarries, Inc., and Howard Construction Co. quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap.

Douglas.—Welton & Gray Gravel Co. and Valentine Supply obtained gravel near Ava for building, paving, and other uses. The Missouri State Highway Department contracted for paving gravel.

Franklin.—The county ranked fourth in total value of sand and gravel production; producers included Pacific Pebbles, Inc., St. Louis Material & Supply Co., Washington Sand Co., Meramec Aggregates, Inc., and the Missouri State Highway Department. Principal uses were for building and paving, but a small quantity of sand was used for grinding and polishing. Limestone and dolomite were quarried and crushed for concrete aggregate, roadstone, riprap, and agstone; producers included H. E. McClain, Inc., George P. Dawson, Inc., Oliver L. Taetz Co., Inc., Edwin Bebermeyer, J. E. McKeever, and the U.S. Army Corps of Engineers. Kaiser Refractories & Chemicals Division, Walsh Refractories Corp., and Thacker & Hoer Mining Co. mined fire clay for use in refractories.

Gasconade.—The county continued to lead in clay production. Seven refractories manufacturers used burley, flint, and diaspore fire clays. Fire clay for chemical uses was mined by General Chemical Division of Allied Chemical Corp. Crushed limestone for concrete aggregate and roadstone was produced for use by the U.S. Army Corps of Engineers.

Gentry.—Building gravel and crushed limestone for concrete aggregate, roadstone and agstone were produced by Albany Gravel Co., Inc.

Greene.—The county ranked third in total value of lime produced and fifth in value of stone produced. Ash Grove Lime & Portland Cement Co. quarried limestone at its Galloway and Springfield quarries for use in making lime and for concrete aggregate, roadstone, and soil conditioner. Griesemer Stone Co., Graystone Quarry Co., W. J. Menefree, and Concrete Co. of Springfield also produced crushed limestone. Dimension marble was prepared by Carthage Marble Corp. at its quarry. Fair Grove Sand Co. produced gravel for paving.

Grundy.—Limestone for concrete aggregate, roadstone, riprap, and soil conditioner was quarried and crushed by Jay Wilcox Limestone Quarry Co. and E. E. Trenary.

Harrison.—Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by Davis-Snyder Quarries, Inc., and L. W. Hayes, Inc.

Henry.—The county continued to lead in coal production; six strip mines produced over 1,000 tons each. Coal was mined by Peabody Coal Co., Bud Jones Coal Co., Redding Coal Co., Hoppe Coal Co., and Madole Bros. Coal Co. Crushed limestone for concrete aggregate, roadstone, riprap, and soil conditioner was produced by Williams Rock Mining Co., Inc., Davis Rock Co., and O. A. Knisely.

Howard.—Glasgow Sand Co. obtained sand for building purposes from local deposits. Crushed limestone for riprap was produced by the U.S. Army Corps of Engineers.

Howell.—The county ranked second in iron ore production. Iron ore was mined by Shook & Fletcher Supply Co. and Riggs & Morrison. The Missouri State Highway Department produced paving gravel.

Iron.—Heyward Granite Co. produced crushed and dimension granite. St. Joseph Lead Co. completed Shaft No. 28 at the Viburnum ore body and operated its 3,000-ton-per-day lead mill.

Jackson.—The county ranked second in value of stone production, third in value of cement and sand and gravel production, and fifth in total value of mineral production. Limestone was crushed at 11 quarries for concrete aggregate, roadstone, riprap, and agstone. Leading producers were Beyer Crushed Rock Co., Union Construction Co., Stewart Sand & Material Co., Centropolis Crusher Co., and Union Quarries. Dimension limestone was prepared by Gerald Hodgins Quarry, Charles Rove Rock Quarry, and George & Clark Stone Contractors. Missouri Portland Cement Co. quarried limestone and shale near Independence for manufacturing portland and masonry cements. The company completed installation of two truck bulk-loading silos. Building and paving sand and gravel was produced by Stewart Sand & Material Co. and Kansas City Quarries Co. Miscellaneous clay for heavy clay products was mined by United Brick & Tile Co. Vermiculite from Montana was exfoliated by The Zonolite Co. Heptene concentrate and sodium cresylate were produced from petroleum fractions by American Oil Co. at its Sugar Creek petrochemical plant.

Jasper.—Jasper County ranked fourth in value of stone and sixth in value of sand and gravel production. Dimension marble for rough building, dressed building, and dressed monumental stone was quarried by Carthage Marble Corp.; the company also produced crushed stone. Nelson Quarries, Independent Gravel Co., and Carthage Crushed Limestone Co. produced crushed limestone for concrete aggregate, roadstone, agstone, and other uses. Miscellaneous stone (chats) was produced by American Zinc, Lead and Smelting Co. and Independent Gravel Co. Grinding and polishing sand, blast sand, paving gravel, and railroad ballast gravel were produced by Independent Gravel Co. Solar Nitrogen Chemicals, owned jointly by Atlas Powder Co. and Standard Oil Co. (Ohio), completed construction of its anhydrous ammonia plant adjacent to the Atlas explosives plant near Joplin.

Jefferson.—The county retained second place in value of sand and gravel produced. Pittsburgh Plate Glass Co., Masters Bros. Silica Sand Co., and Manley Sand Division, Martin-Marietta Corp., quarried high-purity silica sand for use in plate glass and for molding, grinding, polishing, blasting, and other industrial uses. Ficken Material Co. and the Jefferson County Highway Department produced building and paving sand and gravel. Crushed limestone was produced by Henry Trautman, Bussen Quarries, Inc., Kitson Bros. Quarry, Paul H. Guidicy, House Springs Quarry, and Hess Quarry. Dimension limestone was prepared by Paul H. Guidicy. Crushed marble for terrazzo and other uses was produced by Marble Products Co. of Georgia.

Armour Agricultural Chemical Co., Nitrogen Division, produced ammonia, nitric acid, ammonium nitrate, and ammonia solutions at its Crystal City plant, using natural gas as raw material. Polystyrene was produced from styrene by The Dow Chemical Co. at its petrochemical plant near Pevely. Mallinckrodt Nuclear Corp. operated its nuclear fuel production center at Hematite.

St. Joseph Lead Co. operated its Herculaneum lead smelter, utilizing three furnaces through April and two furnaces the remainder of the year.

Johnson.—W. J. Menefee, Dietz Hill Development Co., and Marr Bros. Quarry operated limestone quarries near Centerview, Robins, and Warrensburg. Crushed limestone was produced for concrete aggregate, roadstone, and soil conditioner.

Knox.—Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by Knox County Stone Co., Inc., and McSorley Lime & Rock Co., Inc.

Lafayette.—Red Stone Co., Dietz Hill Development Co., and the U.S. Army Corps of Engineers produced crushed limestone for concrete aggregate, roadstone, and riprap. Sand was dredged for building and paving purposes by Glasgow Sand Co. and Raymond Drivers Sand Co. Coal was mined underground by Jones Coal Co., Earl Ashford Coal Co., and F. W. Goodloe Coal Co.

Lawrence.—Limestone was quarried and crushed for use by the Missouri State Highway Department for concrete aggregate and roadstone. The Missouri State Highway Department contracted for paving gravel.

Lewis.—Paving sand and gravel was obtained near LaGrange by Missouri Gravel Co. Limestone was quarried for concrete aggregate, roadstone, riprap, agstone, and railroad ballast by Hamill Lime Co. and Missouri Gravel Co.

Lincoln.—Watson Quarry and Lincoln Quarry mined and crushed limestone for concrete aggregate, roadstone, and soil conditioner. The Missouri State Highway Department contracted for paving gravel.

Linn.—Bailey Limestone Co. quarried and crushed limestone for concrete aggregate, roadstone, and agstone.

Livingston.—Limestone was quarried and crushed for concrete aggregate, roadstone, riprap, and soil conditioner by Trager Quarries, Inc., Farmers Rock & Lime, Inc., and Fred McVey Quarry. Building sand, railroad ballast sand, and paving gravel were produced by Cooley Gravel Co. and Sampsel Gravel Co. Miscellaneous clay for use in brick and tile was mined by Midland Brick & Tile Co.

Macon.—Macon County ranked third in coal production. Peabody Coal Co. strip-mined coal at its Bee-Veer mine.

Madison.—National Lead Co. mined ores containing lead, copper, silver, cobalt, and nickel at its Madison mine at Fredericktown. The company closed the Madison mine on January 31 and ceased operating the Government-owned cobalt-nickel refinery in March. As a result, the value of minerals produced dropped from $4.2 million in 1960 to $726,000. Crushed stone for use as terrazzo was produced by Marble Products Co. of Georgia.

Maries.—Diaspore, burley, and other fire clays were used by A. P. Green Fire Brick Co.; Refractories Division, H. K. Porter Co., Inc.; and Dillon Bros. Smith Quarries produced crushed limestone for agstone, concrete aggregate, and roadstone. The Missouri State Highway Department contracted for paving gravel.

Marion.—Quicklime and hydrated lime were produced by Marblehead Lime Co. from limestone quarried near Hannibal. S. D. Fessenden & Sons and Marblehead Lime Co. produced crushed limestone for asphalt filler, soil conditioner, concrete aggregate, and roadstone.

Mercer.—Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Twin State Quarries, Inc., and Wilcox Quarries.

Miller.—C. W. Roweth Co. and Elam Construction Co., Inc., produced building sand and building and railroad ballast gravel. The Missouri State Highway Department contracted for paving gravel. Limestone was quarried and crushed for agstone, concrete aggregate, and roadstone by Eldon Quarry Co.

Moniteau.—Moniteau County Agricultural Association, Inc., quarried and crushed limestone for concrete aggregate, roadstone, and agstone. Limestone for riprap was produced by the U.S. Army Corps of Engineers. The Missouri State Highway Department contracted for paving gravel.

Monroe.—Fire clay for use in horizontal zinc retorts and condensers was mined by Gilliam Mining Co. and Fluetsch Bros. Walsh Refractories Corp. used fire clay for refractories. Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Hamilton Lime Co., Central Stone Co., and Wilkerson Bros.

Montgomery.—The county ranked fifth in value of clay production. Fire clay for refractories was mined by six companies. Crushed limestone was produced for concrete aggregate, roadstone, and agstone by McClain Lime Quarry. Building and paving sand and gravel was produced by Two Rivers Sand & Gravel Co. The Missouri State Highway Department contracted for paving gravel.

Newton.—The Southwest Lime Co. produced quicklime from limestone quarried locally; crushed limestone was sold for agstone, concrete aggregate, roadstone, and riprap. Tripoli from Ottawa County, Okla., was processed at Seneca by the American Tripoli Division of The Carborundum Co.

Nodaway.—Limestone was quarried and crushed for concrete aggregate, roadstone, and soil conditioner by Dillon Stone Co. Sand and gravel for building and fill was dredged by Earl Wilson Sand Co.

Oregon.—The county ranked third in value of iron ore production. Brown iron ore was strip-mined by Schroeder Mining Co. of Missouri and Plateau Iron Ore Corp. O. O. Mainprize quarried and crushed limestone for soil conditioning, concrete aggregate, and roadstone. The Missouri State Highway Department contracted for paving gravel.

Osage.—Osage County ranked sixth in value of clays produced. Diaspore, burley, and fire clays were mined for A. P. Green Fire Brick Co. and Kaiser Refractories and Chemicals Division for manufacturing refractories. Paving gravel was produced by the Osage County Highway Department.

Pemiscot.—Taylor Sand & Gravel Co. produced building and paving sand and gravel from local deposits. The Missouri State Highway Department contracted for paving gravel.

Perry.—Gibbar Bros., Inc., produced crushed limestone for concrete aggregate, roadstone, agstone, and riprap and gravel for paving.

Pettis.—Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Howard Construction Co. and W. J. Menefee Construction Co.

Phelps.—Fire clay for refractories was mined by A. P. Green Fire Brick Co. and Dillon Bros. Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Nivens Lime Quarry and Bray Construction Co. Building sand and building, paving, and fill gravel were produced by Grisham Sand & Gravel Co. The Missouri State Highway Department obtained gravel and limestone for road construction and maintenance.

Pike.—Hamill Lime Co., Magnesium Mining Co., and Galloway Limestone Co. quarried and crushed limestone for concrete aggregate, roadstone, and soil conditioner. The Missouri State Highway Department contracted for paving gravel. Methanol, formaldehyde, pentaerythritol, and ammonia were manufactured from natural gas by Hercules Powder Co. at its petrochemical plant near Louisiana.

Platte.—Limestone was quarried and crushed for concrete aggregate, roadstone, and riprap by Everett Quarries, Inc., and the U.S. Army Corps of Engineers. Shale for manufacturing lightweight aggregate was mined by Carter-Waters Corp.

Polk.—Gravel for building, paving, and fill was obtained from deposits near Humansville by Butcher Gravel Co. The Missouri State Highway Department contracted for paving gravel.

Pulaski.—Building sand and gravel and fill gravel were produced by J. H. Walser Construction Co. and Big Piney Sand Co. The Missouri State Highway Department contracted for paving gravel.

Putnam.—Husted Bros. Coal Co. and Kirkville Coal Co. strip-mined coal; Clark Coal Co. mined coal underground.

Ralls.—The county ranked fourth in value of cement output. Universal Atlas Cement Co. produced portland and masonry cements from limestone and shale quarried at its plant near Ilasco. Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Central Stone Co. Edward B. Cooper obtained paving gravel locally. Couch Coal Co. strip-mined coal.

Randolph.—The county ranked second in value of coal output. Peabody Coal Co. and Amidei Coal Co. strip-mined coal; D. L. Bradley Coal Co., Fately Coal Co., and Nejedly Coal Co. mined coal underground. N. J. Cooksey Co. and Potter Stone Co. quarried and crushed limestone for concrete aggregate, roadstone, and soil conditioner.

Ray.—Steva Stone Co. and Orrick Stone Co. quarried and crushed limestone for concrete aggregate, roadstone, riprap, agstone, and other uses.

St. Charles.—St. Charles County ranked fifth in value of sand and gravel production. Tavern Rock Sand Co. produced sands for glass, molding, ferrosilicon, and other industrial uses. The Missouri State Highway Department contracted for paving gravel. Limestone was quarried and crushed for concrete aggregate, roadstone, riprap, and agstone by St. Charles Quarry Co., O'Fallon Quarry & Supply Co., Joerling Bros. Quarry, and Schiermeier Limestone Co. Ultrapure silicon metal for electronic uses was produced by Monsanto Chemical Co. at its plant near St. Charles.

St. Clair.—The county ranked fourth in value of coal production. Pittsburgh & Midway Coal Mining Co. strip-mined coal at its Pioneer mine near Appleton City. George M. Baker Co. and Hunt Limestone Co. quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. J. L. Pohl produced crushed limestone for use in contract construction for the Missouri State Highway Department. The highway department also had other contracts for paving gravel.

St. Francois.—The county led in value of lead, iron ore, and zinc and ranked second in value of lime and total minerals. Iron ore (hematite) was mined underground by Midwest Ore Co. at its Iron Mountain mine. St. Joseph Lead Co. mined lead ore and operated its Bonne Terre, Leadwood, and Federal mills. The company closed its Bonne Terre mine in August, its Bonne Terre mill in September, and its National mine in October. The Federal mill was converted to all-flotation, with a copper concentrate circuit. Zinc flotation circuits were operated at the Leadwood mill. Chats from lead and iron ore milling was used mainly for concrete aggregate, roadstone, and railroad ballast; producers included St. Joseph Lead Co. and Trap Rock Material & Engineering Co. Valley Dolomite Corp. produced dead-burned dolomite for refractory uses; dolomite was crushed for use as agstone, flux, refractory material, railroad ballast, and filler. St. Joseph Lead Co. quarried dolomite for agricultural and fluxing purposes.

Ste. Genevieve.—Ste. Genevieve County led in lime production and ranked third in stone output and fourth in total value of mineral production. Mississippi Lime Co. quarried and crushed limestone to produce quicklime and hydrated lime at its plant near Ste. Genevieve. The company sold crushed limestone for glass, whiting, asphalt filler, coal-mine rock dust, poultry grit, chemicals, concrete aggregate, roadstone, agstone, and flux. Crushed limestone was produced by Cliffdale Quarry & Manufacturing Co. and Ste. Genevieve Building Stone Co. Dimension marble was produced by Weiler Marble Co., Inc., and Tennessee Marble Co. Ed L. Bauman furnished sand and gravel for building and paving.

St. Louis.—St. Louis County led in output of cement, stone, sand and gravel, and total minerals. Portland and masonry cements were manufactured at Prospect Hill by Missouri Portland Cement Co. and at Lemay by Alpha Portland Cement Co. Universal Atlas Cement Co. constructed a 50,000-barrel distribution station which was supplied by barge from the company Hannibal cement plant.[8] Crushed and dimension limestone was produced by West Lake Quarry & Material Co. Producers of crushed limestone included Vigus Quarries, Inc., Riverview Stone & Material Co., Rock Hill Quarries Co., and Bussen Quarries, Inc. Sand and gravel for construction, unground industrial sands, and ground sands were marketed; leading producers, by value, included Pioneer Silica Products Co., Winter Bros. Material Co., Inc., Meramec Sand & Gravel Co., Norman Bros., Inc., and St. Charles Sand Co. Shale for heavy clay products was mined by Alton Brick Co., W. S. Dickey Clay Manufacturing Co., and Hydraulic Press Brick Co. Fire clay was mined by Thomas Mining Corp. and Refractories Division, H. K. Porter, Inc. A small quantity of petroleum was produced.

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[8] Rock Products, v. 64, No. 12, December 1961, p. 50.

Monsanto Chemical Co. produced calcium phosphate, bisphenol, maleic anhydride, and fumaric acid. The company's $10 million research center was completed. Research in plastics, organic chemicals, and inorganic chemicals was conducted. Titanium pigments were produced by Titanium Division of National Lead Co. from ilmenite concentrates produced at the company's Tahawus, N.Y., operation. Barite was ground by the DeLore Division of National Lead Co. Zonolite Co. exfoliated vermiculite from Western States. Perlite was expanded by J. J. Brouk & Co. from perlite mined in Western States.

Saline.—Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by Hall & Riley Quarries, Howard Construction Co., Gilliam Rock, Inc., the U.S. Army Corps of Engineers, and the Missouri State Highway Department.

Shannon.—Shannon County ranked fourth in iron ore production. Shook & Fletcher Supply Co. mined brown iron ore. Crider Bros. Lime Co. quarried and crushed limestone for soil conditioning. Dimension sandstone was produced by Ozark Stone Products, Inc., and Salem Stone Co. The Missouri State Highway Department contracted for paving gravel.

Shelby.—Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Central Stone Co. and Turner Lime & Rock Quarry.

Stoddard.—Hill & Stuart, Inc., Brown Sand & Gravel Co., Inc., and Warren Gravel Co. produced building and paving sand and gravel. The Missouri State Highway Department contracted for paving gravel.

Sullivan.—Howard Construction Co. and Twin State Quarries, Inc., quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap.

Taney.—Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and filler by Poulin & Son Rock & Lime Co.

Texas.—Limestone was quarried and crushed for soil conditioning by Long Bros. The Missouri State Highway Department produced and contracted for paving gravel.

Vernon.—M. L. Schooley Coal & Construction Co. and Ellis Coal Co. produced coal from strip mines. Limestone was quarried and crushed for concrete aggregate and roadstone by Jones Coal & Rock Co., Trager Quarries, Inc., and Alvis Limestone & Concrete Products, Inc. Dressed and sawed dimension sandstone was produced by Missouri Native Stone Corp. Paving gravel for road maintenance was produced by Osage Township and Montevallo Township.

Warren.—Fire clay for refractories was mined for Harbison-Walker Refractories Co., Walsh Refractories Corp., and Kaiser Refractories and Chemicals Division. Sprick Quarry produced crushed limestone for concrete aggregate, roadstone, and agstone. The U.S. Army Corps of Engineers obtained crushed limestone for riprap. Gravel for paving was obtained by the Missouri State Highway Department.

Washington.—All barite produced in the State was from Washington County. Barite production was reported from 16 operations by 11 companies. Leading producers were Magnet Cove Barium Corp., Milwhite Mud Sales Co., Midwest Mining Co., Baroid Division of National Lead Co., and De Soto Mining Co. Mount Sand & Gravel

Co. and Midwest Mining Co. produced building sand and gravel and railroad ballast gravel. St. Joseph Lead Co. mined and milled lead ore at its Indian Creek Plant. Lead was recovered as a byproduct in mining and washing barite. Meramec Mining Co. continued development of the Pea Ridge iron ore deposit.

Wayne.—Williamsville Stone Co. obtained building sand and gravel from local deposits. Limestone was quarried and crushed for concrete aggregate and roadstone by Harris Lime Co. Brown iron ore was mined by various producers and shipped to steel mills.

Worth.—Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Grand River Limestone Co. and Howard Construction Co.

Wright.—W. H. Bennett Quarries, Inc., produced crushed limestone for agstone, concrete aggregate, and roadstone. The Missouri State Highway Department contracted for paving gravel.

The Mineral Industry of Montana

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology.

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COPPER production in Montana in 1961 was 104,000 short tons—the largest since World War II. This output came from the Berkeley pit, Kelley mine, and vein-ore mines at Butte, Silver Bow County. Mineral-fuel activity was highlighted by a record production of 30.9 million barrels of crude petroleum. There was considerable drilling throughout the oil-producing areas of the State. In contrast to the increased output of copper and crude petroleum, lead and zinc production continued to decrease—only 2,600 short tons of lead (least since 1932) and 10,300 short tons of zinc (least since 1938) were produced. The Jack Waite lead-zinc mine in Sanders County was closed in March. Zinc production in 1961 was recovered mostly from old smelter slag in Lewis and Clark County.

Output of natural gas, coal, sand and gravel, stone, cement, lime, and vermiculite increased. The production of the following commodities declined: Chromite, gold, manganese, silver, fluorspar, phosphate rock, and talc. The total value of mineral production in the State of $183.4 million was $4.5 million greater than in 1960, a 3-percent increase. The production-quantity index (tons, barrels, and so forth) increased 9 points, from 114 to 123 (1959=100).

Crude petroleum, copper, and sand and gravel provided 82 percent of the total value of mineral production in the State.

Chromite and tungsten production in Montana ceased when the two producing mines were closed.

Consumption, Trade, and Markets.—Construction in Montana increased as the result of record highway construction, defense projects, and preliminary work on two dams. Employment in the construction industry gained 5 percent. The Montana Highway Commission awarded $42.6 million in contracts, 38 percent more than in 1960. Included were 83 miles of Interstate Highway, 129 miles of primary road, 168 miles of secondary road, and 9,231 feet of structures. The defense projects in the State included missile-base construction in the

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TABLE 1.—Mineral production in Montana [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Chromium ore and concentrate [2] ..... short tons, gross weight	106,716	$3,813	82,258	$2,939
Clays [3] ..... thousand short tons	63	77	55	76
Coal (bituminous and lignite) ..... do	313	1,188	371	1,207
Copper (recoverable content of ores, etc.) ..... short tons	91,972	59,046	104,000	62,400
Fluorspar ..... do	31,273	(4)	14,905	(4)
Gold (recoverable content of ores, etc.) ..... troy ounces	45,922	1,607	35,377	1,238
Iron ore (usable) ..... thousand long tons, gross weight	55	293	34	209
Lead (recoverable content of ores, etc.) ..... short tons	4,879	1,142	2,643	544
Lime ..... thousand short tons	(4)	(4)	118	986
Manganese ore and concentrate (35 percent or more Mn) short tons, gross weight	29,036	1,996	17,514	1,412
Manganiferous ore and concentrate (5 to 35 percent Mn) ..... do	676	11	2,236	33
Natural gas ..... million cubic feet	33,418	2,373	33,901	2,509
Petroleum (crude) ..... thousand 42-gallon barrels	30,240	72,878	30,907	74,795
Peat ..... short tons	-----	-----	7,385	112
Sand and gravel ..... thousand short tons	12,589	11,657	14,702	13,506
Silver (recoverable content of ores, etc.) ..... thousand troy ounces	3,607	3,265	3,490	3,227
Stone ..... thousand short tons	1,183	1,576	1,512	1,849
Uranium ore ..... short tons	1,726	29	729	10
Zinc (recoverable content of ores, etc.) ..... do	12,551	3,238	10,262	2,360
Value of items that cannot be disclosed: Barite, cement, gem stones, gypsum, mica, natural gas liquids, phosphate rock, talc, tungsten, vermiculite, and values indicated by footnote 4	-----	15,217	-----	14,853
Total Montana [5]	-----	178,854	-----	183,354

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes tonnage used for ferrochromium production; included with "Value of items that cannot be disclosed."

[3] Excludes fire clay; included with "Value of items that cannot be disclosed."

[4] Figure withheld to avoid disclosing individual company confidential data.

[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

Great Falls-Lewiston areas. Yellowtail and Clark Canyon Dams were under construction.

Nonagricultural employment declined less than 1 percent. Personal income per capita decreased slightly because a drought lessened income from farm sources. In contrast, personal income per capita in the United States gained 2 percent.

Employment and Injuries.—Employment in the metal-mining industry continued to decline because markets were poor and mines were closed. Employment in petroleum and natural-gas production also declined, although the production trend in this industry was upward.

Injury statistics in table 6 were compiled by the Bureau of Mines from reports by the mining companies.

Legislation and Government Programs.—State legislation concerning eminent domain in the acquisition of surface property for mining was enacted. Condemnation and appraisal procedures were about the same as those used for highways; property owners were to be paid the value of similar residential property in a similar area not affected by open-pit mining. The new law was necessary to extend the boundaries of existing open-pit operations at Butte as well as to begin any new open-pit mining in the future.

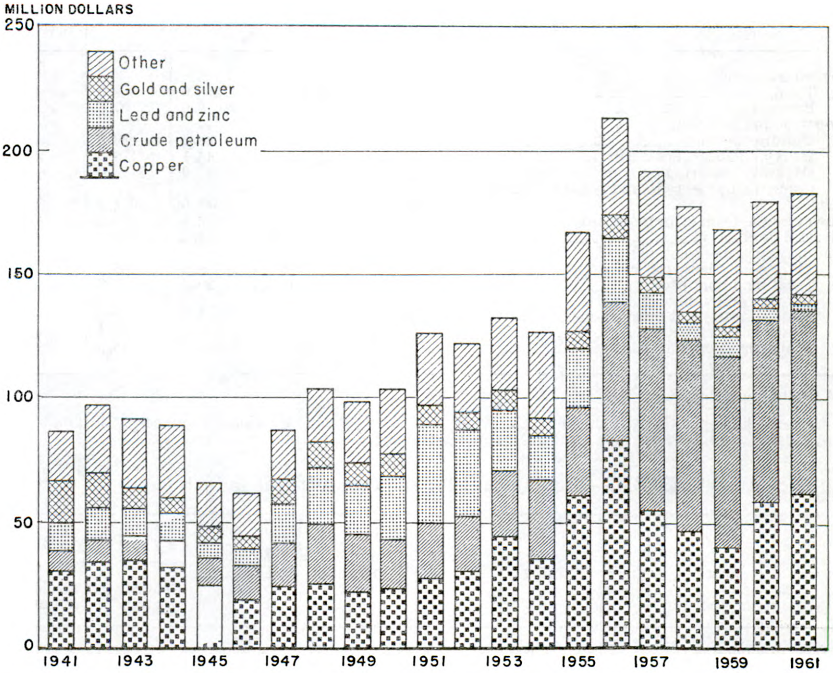

FIGURE 1.—Value of copper, crude petroleum, lead and zinc, gold and silver, and total value of mineral production in Montana, 1941–61.

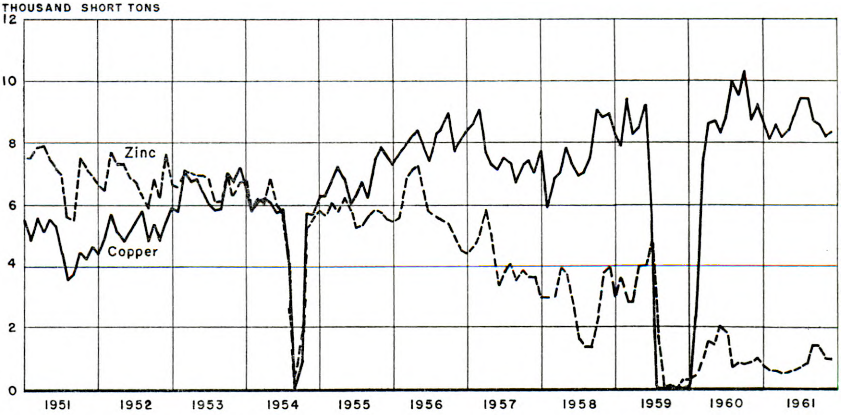

FIGURE 2.—Mine production of copper and zinc in Montana, 1951–61, by months, in terms of recoverable metals.

TABLE 2.—Indicators of Montana business activity

	1960	1961 [1]	Change, percent
Personal income:			
Total...million dollars	1,368.0	1,369.0	+0.1
Per capita...dollars	2,018.0	2,007.0	−0.5
Construction activity:			
Building permits...million dollars	33.6	33.9	+0.9
Heavy engineering awards...do	45.1	178.5	+295.8
Highway construction contracts awarded...do	30.9	42.6	+37.9
Cement shipments to and within Montana thousand 376-pound barrels	1,078.0	1,085.3	+0.7
Cash receipts from farm marketing...million dollars	405.6	374.6	−7.6
Mineral production...do	178.9	183.4	+2.5
Annual average employment:			
Total nonagricultural industries...thousands	166.8	166.2	−0.4
Total manufacturing...do	20.4	20.2	−0.9
Lumber and timber industries...do	7.3	7.3	0.0
Metal-mining and primary-metal industries...do	8.2	7.8	−4.8
Contract construction...do	11.0	11.6	+5.4
Transportation and utilities...do	19.0	18.3	−4.6

[1] Preliminary figures.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Montana Highway Commission, The Farm Income Situation, Montana Labor Market, and Bureau of Mines.

TABLE 3.—Employment for selected mineral industries

Year	Total mining	Metal mining	Nonmetals, including coal	Petroleum and natural gas	Processing	
					Primary metals	Petroleum refining
1952–56 (average)	11,800	8,500	1,000	2,300	3,900	(1)
1957	11,300	7,500	900	2,900	4,900	1,200
1958	8,700	5,300	700	2,700	4,200	1,000
1959	7,800	4,600	700	2,500	3,100	900
1960	7,400	4,500	700	2,200	3,800	900
1961	6,900	4,200	700	2,000	3,600	900

[1] Data not available before 1953.

Source: Montana State Employment Service, Montana Labor Market. Excludes proprietors and self-employed. Industry groups may vary from those in the Bureau of Mines canvass.

TABLE 4.—Hours and earnings data in mining and related industries

Industry	1957	1958	1959	1960	1961
Mining, average:					
Weekly earnings	$96.79	$97.42	$101.91	$103.74	$107.33
Weekly hours	38.9	39.6	40.6	39.9	39.9
Hourly earnings	$2.49	$2.46	$2.51	$2.60	$2.69
Metal mining, average:					
Weekly earnings	$92.78	$93.56	(1)	$101.79	$106.52
Weekly hours	38.2	38.5	(1)	39.0	39.6
Hourly earnings	$2.43	$2.43	(1)	$2.61	$2.69
Primary-metals processing, average:					
Weekly earnings	$90.55	$91.57	(1)	$96.53	$102.40
Weekly hours	39.9	39.3	(1)	39.4	40.0
Hourly earnings	$2.27	$2.33	(1)	$2.45	$2.56

[1] Strike in metal-mining industry beginning Aug. 19, 1959, unsettled at yearend.

Source: Montana State Employment Service, Montana Labor Market. Hours and earnings data exclude administrative and salaried personnel. Average weekly and hourly earnings include overtime and other premium pay.

TABLE 5.—Employers, wage earners, and wages in mining

Fiscal year	Average number of employers	Average number of wage earners	Wages (thousands)	Average annual wage
1952–56 (average)	514	11,301	$53,709	$4,753
1957	526	12,021	65,017	5,409
1958	448	9,019	48,503	5,378
1959	416	8,722	46,017	5,276
1960	492	6,641	36,031	5,426
1961	480	7,453	44,092	5,916

Source: Unemployment Compensation Commission of Montana, Montana Labor Market. Industries and employment covered under unemployment insurance laws of Montana.

TABLE 6.—Injuries in the mineral industries

Year and industry	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:						
Quarries and mills [1]	175	288	403,288		1	2
Nonmetal mines and mills	817	257	1,684,628		58	34
Sand and gravel operations	222	137	242,886		8	33
Metal mines and mills	3,885	255	7,927,671	3	166	21
Coal mines	161	155	200,026		7	35
Total	5,260	248	10,458,499	3	240	23
1961: [2]						
Quarries and mills [1]	178	285	406.006		2	5
Nonmetal mines and mills	713	210	1,198,661		31	26
Sand and gravel operations	245	165	324,563		13	40
Metal mines and mills	3,469	279	7,742,278	3	106	14
Coal mines	159	145	179,560	1	12	72
Total	4,764	259	9,851,068	4	164	17

[1] Includes cement- and lime-processing plants.
[2] Preliminary figures.

Two lead-zinc contracts active under the Office of Minerals Exploration (OME) program involved work by Northern Milling Co., Inc., Broadwater County, and Swansea Mines, Inc., Lewis and Clark County. The contracts were for $102,300 and $18,260, respectively; Government participation was 50 percent.

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—Production of primary aluminum from The Anaconda Aluminum Co. plant at Columbia Falls increased 10 percent over that of 1960. The company annual report to shareholders stated that the output of 62,466 tons from the plant's two potlines was the largest since operations began in 1955. The plant operation, which had been at 87.5 percent of capacity since mid-1959, was increased to full capacity (approximately 65,000 tons annually) on May 1. Aluminum deliveries exceeded production, causing stocks to decrease during the year.

Toward yearend, the company announced that a feasibility study that might result in adding another potline to the Columbia Falls plant was being conducted. Anaconda Aluminum produced more fabricated than primary aluminum—primary expansion could correct this imbalance and permit the company to halt purchases from competitors.

Chromium.—The Stillwater County chromite mining and milling operation of American Chrome Co. at Nye added 82,258 tons of chromite concentrate to the Government stockpile before the mine and mill were closed on September 29 and October 2, respectively. This output completed the 900,000-ton contract which was negotiated with the Defense Minerals Procurement Agency in 1952.

The American Chrome pilot smelter, built in 1958 at the mill-site, was shut down on October 12. Medium-carbon ferrochromium was produced from the concentrated Mouat mine ore and marketed to eastern stainless steel producers. At yearend, the company was seeking a Federal contract to smelt 900,000 tons of stockpiled concentrate to ferrochromium.

Copper.—Copper production was the largest since 1944, an increase of 13 percent (12,028 tons) over the 1960 total (91,972 tons). More than 99 percent of the output came from The Anaconda Company mines in the *Summit Valley* (*Butte*) mining district, Silver Bow County. Copper output from the Berkeley pit increased (5,425 tons) and more than offset a decline from the Kelley mine (3,272 tons) and loss of production from the Alice pit (135 tons in 1960), which was closed in August 1960.

Ore mined at the Kelley block-caving operation decreased to a daily average of 7,500 tons. The Berkeley pit operation was expanded to 31,310 tons; mill heads from the pit contained from 0.70 to 0.78 percent copper.

A shaft development program, begun in 1960 to tap high-grade copper ore reserves at depth, was continued. The Kelley No. 1 shaft was extended and concreted from a depth of 2,736 to 3,380 feet; the Mountain Con shaft was sunk to a depth of 5,296 feet—the first time the mile mark was reached in any Butte shaft; the Steward subshaft was sunk and concreted 622 feet below the 4,000 level; and plans were made to extend the Neversweat shaft from the 2,800 to the 4,500 level to provide adequate ventilation for the deeper levels. The shaft-development program was the subject of a report.[4]

The Anaconda Company announced plans to construct a new copper concentrator adjacent to the Berkeley pit. When the plant has been completed (plans indicate a 3-year project), it will beneficiate copper ore from Butte mines, thereby eliminating transportation of crude ore to Anaconda, Deer Lodge County. Other operations were to continue at Anaconda as in the past.

Gold.—Gold output declined 23 percent to 10,545 ounces from the 45,922 ounces produced in 1960. Placer output—second lowest since the turn of the centry—was 3 ounces below the 1960 total. Of the three largest Montana gold-producing properties—Mayflower and West Mayflower (Madison County) and the Berkeley pit and Kelley (Silver Bow County)—only the production of the Berkeley pit operation increased over that in 1960; the output of the other two decreased sizably.

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[4] Mining World. Mining Goes Deeper With Anaconda. V. 12, No. 2, February 1961, pp. 24–25.

Gold recovered from base-metal ores was 54 percent of the State total; gold, gold-silver, and silver ores yielded 43 percent; the remainder came from old tailings, mill cleanings, and stream gravel.

Silver Bow County operations supplied 52 percent of the State total, followed by Madison (35 percent), Granite (4 percent), Beaverhead (3 percent), Jefferson (2 percent), and 14 other counties (the remainder).

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy (thousands)	Value (thousands)
1952–56 (average)	134	9	6,525	27,767	$972	6,294	$5,697
1957	125	13	10,790	32,766	1,147	5,558	5,030
1958	125	11	10,861	26,003	910	3,631	3,286
1959	96	14	8,779	28,551	999	3,420	3,096
1960	129	13	12,317	45,922	1,607	3,607	3,265
1961	135	17	12,792	35,377	1,238	3,490	3,227
1862–1961			([3])	17,658,000	402,475	832,897	622,939

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)	75,376	$50,469	18,344	$5,413	72,503	$19,022	$81,572
1957	91,512	55,090	13,300	3,804	50,520	11,721	76,792
1958	90,683	47,699	8,434	1,974	33,238	6,781	60,649
1959	65,911	40,469	7,672	1,765	27,848	6,405	52,734
1960	91,972	59,046	4,879	1,142	12,551	3,238	68,298
1961	104,000	62,400	2,643	544	10,262	2,360	69,770
1862–1961	7,684,000	2,541,200	917,000	143,144	2,671,000	505,611	4,215,369

[1] Includes recoverable metal content of gravel washed (placer mines), or milled, old tailings retreated, and ore, old slag, and copper precipitates shipped to smelters during the calendar year indicated. Owing to rounding, individual items may not add to totals shown.
[2] Does not include gravel washed.
[3] Data not available.

TABLE 8.—Gold production at placer mines

Year	Mechanical and hydraulic methods			Small-scale hand methods			Total		
	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)
1952–56 (average)	4	196	1,504	[1] 5	1	31	8	197	1,535
1957	8	170	724	5	1	78	13	171	802
1958	7	209	1,069	4	1	19	11	210	1,088
1959	9	157	973	5	4	29	14	161	1,002
1960	2	2	41	11	8	94	13	10	135
1961	[2] 5	30	82	12	4	50	17	34	132

[1] Includes surface and underground (drift) placers.
[2] Includes 3 dragline dredges and 2 nonfloating washing plants.

TABLE 9.—Mine production of gold, silver. copper, lead, and zinc in 1961, by counties, in terms of recoverable metals [1]

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Beaverhead	16		1,217	$43	51,514	$48
Broadwater	6	(2)	600	21	1,941	2
Deer Lodge	7		82	3	9,687	9
Fergus	2		9	(3)	128	(3)
Granite	20	1	1,311	46	456,414	422
Jefferson	18	2	630	22	41,011	38
Lewis and Clark	16	4	285	10	19,650	18
Madison	15		12,266	429	75,250	70
Meagher	5	1	69	2	4,994	5
Powell	6	5	300	11	229	(3)
Ravalli	2		7	(3)	1,045	1
Silver Bow	11	1	18,391	644	2,765,478	2,557
Undistributed [4]	11	3	210	7	63,009	58
Total	135	17	35,377	1,238	3,490,350	3,227

County	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaverhead	7	$4	164	$34	43	$10	$138
Broadwater			17	4	8	2	28
Deer Lodge	4	2					14
Fergus			3	1	1	(3)	1
Granite	112	67	435	90	2,545	585	1,210
Jefferson	14	8	166	34	103	24	126
Lewis and Clark	19	11	610	126	5,961	1,371	1,536
Madison	6	4					502
Meagher	3	2	195	40	18	4	53
Powell							11
Ravalli			6	1	1	(3)	3
Silver Bow	103,788	62,273	435	90	1,384	318	65,881
Undistributed [4]	47	28	612	126	198	46	265
Total	104,000	62,400	2,643	544	10,262	2,360	69,770

[1] Owing to rounding, individual items may not add to totals shown.
[2] From property not classed as a mine.
[3] Less than $500.
[4] Includes Carbon, Flathead, Lincoln, Mineral, Missoula, Phillips, and Sanders Counties; combined to avoid disclosing individual company confidential data.

Iron Ore.—Iron ore production declined 21,213 long tons from the 1960 total, largely because shipments were curtailed from the Young-Montana Corp. Willow Creek mine near Stanford, Judith Basin County. Young-Montana shipped 16,378 tons before it terminated work at this property in November. Ralls & Harris Bros. mined and shipped 17,890 tons of iron ore (magnetite) from the Iron Cross and Iron Magnet properties near Radersburg, Broadwater County.

Lead.—Production of lead, the least since 1932, declined 46 percent from the 1960 total. Increased shipments from The Anaconda Company East Helena slag-fuming operation and from its Emma mine stockpile at Butte, along with production increases from the Nancy Lee lease (Ernie G. Smith), Mineral County, and the Algonquin mine (Trout Mining Co.), Granite County, failed to offset the loss of over 1,800 tons of production because The Anaconda Company Alice pit operation was inactive. Production from the Jack Waite mine, Sanders County, ceased in March when American Smelting and

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	43	10.428	13,550	47,958	6,100	30,800	28,400
Dry gold-silver	15	3,327	1,210	36,195	8,100	20,200	23,800
Dry silver	32	15,847	424	126,274	49,100	202,700	92,200
Total	90	29,602	15,184	210,427	63,300	253,700	144,400
Copper	9	12,533,042	18,133	2,679,279	199,548,400	----------	----------
Lead	18	12,747	308	60,635	92,800	2,116,700	500,900
Lead-zinc	5	361	32	3,305	1,000	129,400	36,100
Zinc and zinc old tailings [2]	5	[3] 132,636	649	448,150	227,500	1,769.400	7,923,200
Total	37	12,678,786	19,122	3,191,369	199,869,700	4,015,500	8,460,200
Other lode material:							
Dry gold old tailings and dry gold mill cleanings [2]	3	103	51	44	----------	300	----------
Dry gold-silver old tailings	8	7,265	672	27,834	13,200	44,700	63,800
Dry silver old tailings	7	19,297	216	60,665	81,600	28,000	17,000
Zinc slag	1	57,335	----------	----------	----------	943,800	11,838,600
Copper precipitates	----------	----------	----------	----------	7.972,200	----------	----------
Total "lode" material	135	12.792,388	35,245	3,490,339	208.000.000	5,286,000	20,524,000
Gravel (placer operations)	17	([4])	132	11	----------	----------	----------
Total	152	12,792.388	35,377	3,490,350	208,000,000	5.286,000	20,524,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Includes 90,425 tons of manganese ore containing gold, silver, copper, lead, and zinc.
[4] 33,880 cubic yards.

TABLE 11.—Mine production of gold, silver, copper, lead, and zinc in 1961, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation	293	17	----------	----------	----------
Concentration and smelting of concentrates	19,533	3,158,208	199,794,300	2,951,400	8,263,300
Total	19,826	3,158,225	199,794,300	2,951,400	8,263,300
Direct smelting:					
Ore	14.429	239,430	136,900	1,287,800	275,900
Old tailings	956	92,666	96,600	102,700	146,200
Old slag and cleanup [1]	34	18	----------	944,100	11,838,600
Copper precipitates	----------	----------	7,972,200	----------	----------
Total	15,419	332,114	8,205,700	2,334,600	12,260,700
Placer	132	11	----------	----------	----------
Grand total	35.377	3,490,350	208,000,000	5,286,000	20,524,000

[1] Combined to avoid disclosing individual company confidential data.

Refining Co. closed the mine and terminated a long-term lease with the Jack Waite Mining Co.

Lewis and Clark County supplied 23 percent of the total lead produced in the State; Granite County and Silver Bow County each supplied 16 percent. Eight other counties yielded the remainder.

Manganese.—Tonnage and value of manganese ore (35 percent or more manganese) decreased 40 and 29 percent, respectively, from the 1960 total; manganiferous ore (5 to 35 percent manganese) production increased 231 percent in tonnage and 190 percent in value.

Three companies—The Anaconda Company, Taylor-Knapp Mining Co., and Trout Mining Co.—produced and sold manganese products. The Anaconda Company shipped from stocks most of the year and produced nodules in its concentrating and sintering plant at Anaconda during September and October. Most of the metallurgical-grade (56.6 percent manganese) nodular manganese was consumed at the company ferromanganese plant at Anaconda.

The Taylor-Knapp company marketed battery-grade manganese ore to dry-cell battery manufacturers and uranium and zinc processors. The Taylor-Knapp and Trout companies completed an agreement whereby Trout shipped manganese ore to the Taylor-Knapp mill and in return Trout beneficiated base-metal ore from Taylor-Knapp mines.

Silver.—The production of silver declined 3 percent (116,641 ounces) from the 1960 total. Increased output from The Anaconda Company Berkeley pit and Butte Hill mines (Mountain Con and Steward) did not offset the lack of production from the inactive Alice pit, which yielded over 500,000 ounces in 1960. Silver obtained from copper ore increased from 2,356,757 to 2,679,279 ounces.

Silver Bow County furnished 79 percent of the State output, Granite County contributed 13 percent, and the remaining 8 percent came from 16 other counties.

Steel.—Gulf State Lands and Industries, Inc., a subsidiary of Webb & Knapp, Inc., applied to the Federal Area Redevelopment Administration (ARA) for financial assistance to construct a steel plant at Anaconda, Deer Lodge County. As proposed, the plant would cost approximately $40 million to construct and would use The Anaconda Company smelter slag and Montana iron ore as raw materials. The ARA had not reached a decision at yearend on the request.

Tungsten.—Tungsten production and value increased, and the grade of ore remained essentially the same. Output came entirely from the Minerals Engineering Co. open-pit operation near Wise River, Beaverhead County, before the mine was closed late in December. At yearend, the company was preparing to close its mill near Glen.

A new hydrochloric-acid-leach process was employed at the mill to upgrade tungsten concentrate from 60 to 70 percent tungsten trioxide (WO_3). In other years, a 60-percent concentrate was upgraded in the Minerals Engineering Co. plant at Salt Lake City, Utah.

Uranium.—Uranium came entirely from the Carbon County underground mines of J. A. Highsmith. Compared with 1960 totals, tonnage and value declined 58 (997 tons) and 65 ($18,984) percent, respectively. The grade of ore mined was slightly lower than in 1960.

Zinc.—Zinc output, the least since 1938, declined 18 percent from the 12,551 tons produced in 1960. The Anaconda Company supplied 71 percent of the State output from the slag-fuming operation at East Helena (the largest zinc-producing operation in the State), and from shipments from stockpiled Emma mine sphalerite-bearing manganese ore. The company did not mine zinc ore during the year. As with other base metals, the lack of production from the inactive Alice pit, which yielded over 4,700 tons of zinc in 1960, largely caused the decline. Trout Mining Co. produced 19 percent of the output of zinc in Montana from the Algonquin mine near Philipsburg, Granite County.

The Anaconda Company zinc concentrator at Anaconda, Deer Lodge County, was operated only during September and October. Anaconda refined purchased and toll concentrates of zinc only at the Great Falls plant. At yearend, development work was resumed on the Elm Orlu-Black Rock low-grade zinc project; market considerations had caused the suspension of work in 1960.

NONMETALS

Barite.—There was a small increase in the quantity and value of barite sold or used by producers. Baroid Sales Division of National Lead Co. mined and ground most of the output near Greenough, Missoula County. The ground barite was used primarily as a weighting agent in oil-well-drilling mud. A small quantity of barite was produced in Lincoln County.

Plans were announced to resume barite mining at the Copper Mountain claims, 5 miles south of Troy, Lincoln County, after the owners, Lendal and Donald Kotschever, uncovered veins of high-grade barite.

Cement.—The quantity and value of cement shipments increased 20 and 21 percent, respectively. Ideal Cement Co., Montana Division (Gallatin County), was the only producer of cement in the State. Of the portland cement sold, 75 percent went to destinations within the State; shipments also were made to Utah, Wyoming, North Dakota, and Colorado. Limestone, sandstone, and gypsum mined locally were used in making the cement.

Permanente Cement Co., Oakland, Calif., associated with a group holding the prime contracts for constructing the Yellowtail Dam near Hardin (Big Horn County), indicated interest in constructing a $10 million cement plant near Helena. Cement requirements for the dam were estimated at 1.3 million barrels.

Clays.—Production of miscellaneous clay was 13 percent less than in 1960; fire-clay output remained about the same. No production of bentonite was reported. Clay for making heavy clay products was dug in Fergus and Yellowstone Counties. Two companies—Treasurelite, Division of Industrial Products, Inc. (Cascade County), and Montana Liteweight Aggregate Co. (Yellowstone County)—produced and expanded shale for use as lightweight aggregate. Fire clay for making firebrick and block and saggers was mined in Cascade and Deer Lodge Counties.[5]

Fluorspar.—Shipments of fluorspar were less than half the 1960 total—14,905 tons compared with 31,273 tons in 1960. An increase in the quantity used in ceramics and at ferroalloy plants was not enough to offset the sharp decrease in steel-industry consumption.

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[5] Montana Bureau of Mines and Geology, Butte. Preliminary Investigation of Clay Deposits in Minnesota, North Dakota, Montana, North Idaho, and Washington. Prepared by Northern Pacific Railway Co. Geologic Division, Properties and Industrial Development Department, open file.

The Roberts Mining Co. operation in Ravalli County continued to be the only source of fluorspar in the State.

Gypsum.—The quantity of crude gypsum mined declined 5 percent; the value increased 12 percent. Uses remained essentially the same as in 1960—the output was mostly calcined and sold as ground gypsum, wallboard, and lath; uncalcined gypsum was used as a retarder in portland cement. Two mines in Fergus County furnished the production.

Lime.—Lime produced at sugar refineries was included as part of the State mineral production for the first time in 1961. Three companies operating four sugar refineries in Big Horn, Missoula, Richland, and Yellowstone Counties calcined limestone for their own use. The Anaconda Company continued to produce quicklime in Deer Lodge County; Elliston Lime Co. was active in Powell County.

Mica.—Shipments of mica to the Government purchase depot at Custer, S. Dak., increased 53 percent, and the value doubled. Production came from the Planet Exploration Corp. Thumper mine in Gallatin County.

Phosphate Rock.—The quantity and value of marketable phosphate rock decreased 8 and 6 percent, respectively. Operations in Beaverhead, Powell, and Silver Bow Counties contributed to the output, which was converted to elemental phosphorus. A part of the phosphate-rock produced was exported to British Columbia for making phosphoric acid and phosphate fertilizers.

The Bunker Hill Co. relinquished its lease on the Jack Pine phosphate claims near Elliston, Powell County. It had been developing the property.

Montana Phosphate Products Co. shipped phosphate rock from a deposit in the Hall-Maxville area of Granite County to Consolidated Mining & Smelting Company of Canada, Ltd., at Trail, British Columbia, for benefication testing.

Sand and Gravel.—A substantial increase in the tonnage of sand and gravel used by the State highway department coupled with additional quantities required by the Bureau of Reclamation raised the output to 14.7 million tons valued at $13.5 million, compared with 12.6 million tons valued at $11.7 million in 1960. The larger production for these agencies more than offset a sizable decrease at U.S. Army Corps of Engineers projects. Of the 56 counties in the State, 35 contributed to the sand and gravel output. Uses did not change substantially; the distribution was road material, 92 percent; building, 6 percent; railroad ballast and miscellaneous, 2 percent; corresponding figures in 1960 were 90, 7, and 3 percent.

TABLE 12.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	800	$1,200	863	$1,116
Road material	554	646	1,029	964
Fill	----------	----------	97	90
Railroad ballast	(1)	(1)	114	85
Other [2]	452	363	19	14
Total	1,806	2,209	2,122	2,269
Government-and-contractor operations:				
Building	56	102	73	145
Road material	10,719	9,342	12,482	11,068
Fill	----------	----------	9	10
Other [2]	8	4	15	15
Total	10,783	9,448	12,580	11,237
All operations:				
Building	856	1,302	936	1,261
Road material	11,273	9,988	13,511	12,031
Fill	----------	----------	107	100
Railroad ballast	(1)	(1)	114	85
Other [2]	460	367	34	29
Grand total [3]	12,589	11,657	14,702	13,506

[1] Included with "Other" to avoid disclosing individual company confidential data.
[2] Sand and gravel used for miscellaneous and unspecified purposes, including items indicated by footnote 1.
[3] Owing to rounding, individual items may not add to totals shown.

Stone.—Increased activity by the Bureau of Public Roads was reflected in the quantity and value of stone output. Production totaled 1.5 million tons valued at $1.8 million compared with 1.2 million tons valued at $1.6 million in 1960. The quantity of limestone, basalt, and sandstone quarried declined; output of granite increased greatly.

Stone production was reported from 18 counties. Gallatin, Deer Lodge, and Carbon Counties were the principal sources of limestone, which was quarried in the greatest quantities. The granite output came mostly from Cascade County; basalt was mined in Flathead, Valley, Park, and Cascade Counties.

Sulfur.—Production of high-purity elemental sulfur from refinery gases were higher than in 1960; shipments also increased. Two oil refineries near Billings, Yellowstone County, provided the raw material to the Montana Sulphur & Chemical Co.

Talc.—Quantity and value of talc mined was about 7 percent less than in 1960. Production was reported by two companies from five mines—two in Beaverhead County and three in Madison County. About 27 percent of the production was shipped to grinding plants in Grand Island, Nebr.; Ogden, Utah; and Los Angeles, Calif. The remainder was ground in Barratts, Beaverhead County, and in Three Forks, Gallatin County. Some of the ground-talc output was exported.

The quantity of talc used in making paint and paper changed materially; uses were as follows (1960 percentages are in parentheses): Paint, 43 percent (67 percent); ceramics, 23 percent (22 percent); and miscellaneous, including paper, cosmetics, insecticides, rice polishing, textiles, and rubber, 34 percent (10 percent).

Vermiculite.—The Zonolite Co. produced 9 percent more crude vermiculite than in 1960. It operated near Libby, Lincoln County, an open pit which continued to be the principal source of vermiculite in the Nation. Some of the production was exfoliated by a company in Great Falls, Cascade County, but most of it was shipped out-of-State to be expanded. Use of vermiculite for masonry-fill insulation and for concrete aggregate in roof-deck applications, as well as for home gardens, agriculture, and animal feeds increased. A highly refined product was supplied to Monsanto Chemical Co. for use in making a stock-feed product.

The Zonolite Co. began stripping overburden from a 30-acre tract adjacent to its producing pit. Milling ore for several years of operation was to be obtained from this area.

MINERAL FUELS

Coal.—There was a 58,000-ton increase in the quantity of bituminous coal and lignite mined compared with 1960. Eighteen mines (14 underground and 4 strip) in nine counties contributed to the total tonnage. Seven mines in Musselshell County furnished 80 percent of the bituminous coal output; Carbon, Rosebud, Blaine, and Cascade County mines also contributed. The lignite came mostly from two mines in Richland County. The steam electric-generating plant of Montana-Dakota Utilities Co. at Sidney continued to be the leading lignite consumer.

Attention was called to a new refinery byproduct—"fluid coke." After this finely divided carbon from the Humble Oil & Refining Co. refinery at Billings had been briquetted, calcined, and crushed, it was tested as a reductant for various metallurgical processes.

Petroleum and Natural Gas.[6]—Recovery of crude oil increased 667,000 barrels to a record high of 30.9 million barrels valued at $74.8 million, compared with 30.2 million barrels valued at $72.9 million in 1960. Petroleum, as in 1960, represented 41 percent of the total value of mineral output in the State. Three fields—Pine, Cabin Creek, and Elk Basin—each produced in excess of 2.5 million barrels, and the combined yield was 39 percent of the State total. Other important fields that produced more than 2 million barrels each were Sumatra, Poplar-East, and Cut Bank. Recovery from the Stensvad field totaled 1.5 million barrels. The Seven Mile, Graben Coulee, Benrud, Monarch, and Pondera Coulee fields came into production.

Ten refineries processed 23.9 million barrels of crude oil; Montana wells furnished 41 percent of the total, and Wyoming wells supplied almost all the remainder. Of the 417 wells drilled during the year, 167 yielded oil, 8 yielded gas, and 233 were dry holes.

Marketed production of natural gas totaled 33.9 billion cubic feet compared with 33.4 billion cubic feet in 1960. Recovery of 12.4 billion cubic feet (11.2 billion in 1960) made Cut Bank (including Reagan) the principal natural-gas-producing field. Eight other fields where recovery was in excess of 1 billion cubic feet (in order of output) were Cedar Creek, Bowdoin, Dry Creek, Keith Block, Whitlash, Cabin Creek, Bowes, and Kevin-Sunburst.

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[6] Montana Oil and Gas Conservation Commission. Montana Oil and Gas Statistical Bulletin and Annual Review. 1961.

There was considerable drilling throughout the producing areas of the State. Concentrated effort was made in the southwestern corner of the Williston Basin along the Cedar Creek anticline, which traverses parts of Fallon, Prairie, and Wibaux Counties. Very little information was released, but there was much activity in the Tule Creek area of Roosevelt County, about 15 miles northwest of the Poplar field. Interest began when the Nisku-Devonian strike was completed in the 1 Sletvold well. Numerous shows had been reported from this formation, but no production had occurred in Montana. An important eastern extension of the Keg Coulee field (Musselshell County) was drilled, and the Pennel field (Fallon County) had a three-horizon producer. There also was interest along the "disturbed belt" on the east front of the Rocky Mountains; the outlook was for a southward extension of the gasfields of Alberta, Canada.

The Phillips Petroleum Co. refinery at Great Falls began a major expansion program that included erecting a new catalytic cracking unit and a distillate hydrogenation unit, expanding and modernizing laboratory facilities, and expanding the refinery's water-cooling system. Farmers Union Central Exchange, Inc., increased crude-charging and fresh-feed catalytic cracking capacity at its Laurel refinery. Texaco, Inc., announced plans to close its Cut Bank refinery. It had operated the facility only intermittently since 1958. Because the Glacier pipeline had been newly constructed, no problems were anticipated in marketing the crude oil produced in the area.

A 430-mile crude-oil pipeline, owned jointly by Continental Pipe Line Co. and Texas Pipe Line Co., was completed from fields in northern Montana near Cut Bank to refinery centers at Billings and Laurel, and then to Bryon in northern Wyoming, where it connected with facilities of the Platte Pipeline Co.

REVIEW BY COUNTIES

Beaverhead.—Tungsten ore mined from the Minerals Engineering Co. Calvert pit near Wise River was trucked 48 miles to a mill near Glen. Acid-leaching equipment was moved from the company's Salt Lake City, Utah plant to the Glen mill to facilitate upgrading the tungsten concentrate. Closing of the mine late in December affected approximately 25 employees; additional employees were to be released upon the planned closure of the mill early in 1962.

The *Argenta* mining district, with seven operating mines, led in production. Lead ore from the Maulden mine, operated by Ida B. Hand, yielded most of the county lead and zinc output. High-grade gold ore was shipped from the Yellow Band property; the Cross mine operation supplied 44 ounces of gold and 887 ounces of silver. Small quantities of lead ore were mined at the Connie, Coolidge, Graybird, and May Day properties.

Spokane National Mines, Inc., shipped 31 tons of silver ore to the East Helena smelter from the New Departure mine in the *Blue Wing*

TABLE 13.—Value of mineral production in Montana, by counties[1]

(Thousand dollars)

County	1960	1961	Minerals produced in 1961 in order of value
Beaverhead	(2)	(2)	Tungsten, phosphate rock, talc, silver, gold, stone, lead, zinc, copper, sand and gravel.
Big Horn	$248	$373	Petroleum, sand and gravel, lime, stone, natural gas.
Blaine	595	611	Petroleum, sand and gravel, natural gas, coal.
Broadwater	264	157	Iron ore, gold, sand and gravel, lead, zinc, silver.
Carbon	7,968	7,409	Petroleum, natural gas, stone, coal, uranium, sand and gravel, gold, silver.
Carter	72	52	Petroleum.
Cascade	730	1,017	Sand and gravel, stone, clays, coal.
Custer	143	128	Sand and gravel, coal.
Daniels	(2)	------------	
Dawson	3,013	3,462	Petroleum, sand and gravel, coal.
Deer Lodge	852	836	Lime, stone, sand and gravel, silver, gold, copper, clays.
Fallon	15,778	16,343	Petroleum, natural gas, sand and gravel.
Fergus	(2)	391	Gypsum, sand and gravel, clays, lead, gold, zinc, silver.
Flathead	405	296	Sand and gravel, stone, silver, peat, gold.
Gallatin	(2)	(2)	Cement, stone, sand and gravel, mica.
Glacier	1,403	1,179	Petroleum, sand and gravel.
Granite	1,403	1,723	Zinc, manganese, silver, lead, copper, gold, manganiferous ore, stone, sand and gravel.
Hill	50	64	Sand and gravel, natural gas.
Jefferson	266	194	Stone, silver, lead, zinc, gold, copper.
Judith Basin	207	124	Iron ore, sand and gravel.
Lake	26	(2)	Peat.
Lewis and Clark	1,709	1,651	Zinc, lead, sand and gravel, silver, copper, gold, stone.
Liberty	328	602	Natural gas, petroleum.
Lincoln	1,710	(2)	Vermiculite, stone, sand and gravel, barite, gold, zinc, silver.
McCone	185	136	Natural gas, petroleum.
Madison	1,347	1,045	Talc, gold, silver, copper.
Meagher	62	53	Lead, silver, zinc, gold, copper, sand and gravel.
Mineral	(2)	(2)	Lead, silver, sand and gravel, zinc, copper, gold.
Missoula	136	193	Sand and gravel, lime, barite, stone, gold.
Musselshell	2,931	4,557	Petroleum, coal.
Park	(2)	54	Sand and gravel, stone.
Phillips	450	340	Natural gas, sand and gravel, stone, gold, silver.
Pondera	25	27	Petroleum, sand and gravel.
Powder River	------------	(2)	Coal.
Powell	(2)	(2)	Phosphate rock, lime, stone, sand and gravel, gold, silver.
Prairie	(2)	(2)	Sand and gravel.
Ravalli	(2)	(2)	Fluorspar, peat, sand and gravel, lead, silver, gold, zinc.
Richland	(2)	715	Coal, petroleum, lime.
Roosevelt	8,864	7,675	Petroleum, sand and gravel.
Rosebud	9,092	6,142	Petroleum, coal.
Sanders	(2)	(2)	Lead, stone, zinc, copper, silver, gold.
Sheridan	1,622	2,380	Petroleum, coal.
Silver Bow	66,353	67,303	Copper, silver, manganese, gold, phosphate rock, zinc, lead, sand and gravel.
Stillwater	(2)	(2)	Chromium.
Sweet Grass	(2)	------------	
Teton	31	34	Petroleum, sand and gravel, stone.
Toole	1,866	1,638	Petroleum, sand and gravel, natural gas.
Treasure	46	32	Sand and gravel.
Valley	495	180	Sand and gravel, stone.
Yellowstone	1,685	1,474	Petroleum, sand and gravel, lime, clays.
Combined counties[3]	21,111	24,932	Petroleum, natural gas.
Undistributed[4]	25,934	28,744	
Total[5]	178,854	183,354	

[1] No production reported in Chouteau and Wheatland Counties.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Petroleum and natural gas production from fields underlying two or more counties. See Combined Counties section.

[4] Includes value of gem stones, natural gas liquids, sand and gravel, and stone that cannot be assigned to specific counties, and values indicated by footnote 2.

[5] Total has been adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

district near Bannack; development operations continued during the year. In December, Spokane National milled custom ore in its plant.

Operations in Beaverhead County yielded 51,514 ounces of silver, a 12,000-ounce increase over the 1960 yield. The leading silver output for a single operation (15,229 ounces) came from the Lively Mining Co. Hecla mine, *Bryant* district; H. L. Patterson Comet mine, *Elkhorn* district, and the Ida B. Hand Polaris mine, *Polaris* district, ranked second and third. Other precious- and base-metal production came from the Hendricks (gold-silver), *Bannack* district; Charter Oak (lead), *Blue Wing* district; Gray Jockey (silver), *Vipond* district; Gulch (gold) and Henry (gold-silver), *Dillon* district; and Quartz Hill (silver tailings), *Quartz Hill* district.

Victor Chemical Works produced phosphate rock at the Canyon Creek and Quartz Hill Mines. It shipped the output to its elemental phosphorus plant at Silver Bow. Some talc from the Smith-Dillon, Crown, and Regal mines of Tri-State Minerals Co. was ground at the Barratts mill.

Big Horn.—Three fields yielded 115,000 barrels of crude oil, slightly less than in 1960. Natural gas withdrawals increased to 54 million cubic feet. Holly Sugar Corp., Hardin, calcined limestone for use in refining sugar.

Blaine.—Recovery of crude oil from the Bowes field decreased to 241,000 barrels from 280,000 barrels in 1960. Natural gas from the same field also was less, 1.1 billion cubic feet compared with 1.4 billion cubic feet in 1960. One bituminous coal mine was active.

Broadwater.—Ralls & Harris Bros. shipped iron ore for use by the cement industry from properties near Radersburg.

The Marietta mine of Northern Milling Co. in the *Park* (*Indian Creek*) mining district was the leading gold, lead, silver, and zinc producer. Exploration and development completed by the company consisted of 492 feet of crosscutting and 300 feet of drifting on the "Gold Dust" vein. The company also operated the Silver Wave gold mine in the same district.

The largest quantity of ore mined in the county came from the *Park* district Diamond Hill gold mine. Gold ore was shipped from the Acme and Hard Cash properties and lead ore, from the January mine.

Carbon.—Uranium ore was mined from the *Butte* district Leo No. 6, Dandy, and Perc No. 14 mines. The Glengarry mine, *Silver Run* district, yielded a small quantity of gold ore.

The county ranked third in value of nonmetal and fuel production, despite declines in output of 194,000 barrels of crude oil and 708 million cubic feet of gas. The Elk Basin oilfield, the largest producing field, continued as the third ranking producer in the State. Withdrawals of natural gas from the Dry Creek field totaled 2.1 billion cubic feet. Two bituminous coal operations were active.

Carter.—Recovery of crude oil from the Repeat field was 26,000 barrels, 13,000 barrels less than in 1960.

Cascade.—The Anaconda Company annual report to shareholders announced that the copper refinery at Great Falls was operated at near its rated capacity of 24.5 million pounds of electrolytic copper a month, that the refinery modernization was two-thirds complete at the end of 1961, and that a new electrolyte purification plant was placed in operation during the year. The electrolytic zinc plant was operated at from 50 to 89 percent of its 27-million-pound monthly capacity. Cadmium, a byproduct of the zinc operation, was obtained at the rate of approximately 100,000 pounds a month. Indium, previously a byproduct of zinc refining, was not produced because the indium content in the material processed was negligible.

American Metal Climax, Inc., completed the third year of diamond drilling at the Big Ben molybdenum deposit near Neihart.

The county continued to lead in value of sand and gravel, but it ranked second in tonnage. It ranked second for both quantity and value of stone output. Fire clay for refractory use at the Anaconda Reduction Works (Deer Lodge County) was dug at the Armington pit. Production was reported from one bituminous coal mine. Robinson Insulation Co., exfoliated vermiculite at its Great Falls plant.

Dawson.—Six oilfields yielded 1.4 million barrels of crude oil. The Glendive and Gas City fields produced 69 percent of the total. Intial output of 16,000 barrels was reported from the Seven Mile field. A small quantity of sand and gravel was produced.

Deer Lodge.—Concentrating and smelting facilities at the Anaconda Reduction Works in Anaconda were improved during the year. Installation of new fluosolids reactors, begun in 1960, was completed, and the reactors were placed in operation. Fluidized-bed roasting of copper concentrate, begun in November, replaced the hearth-roasting process used previously. The capacity of two reverberatory furnaces was doubled by widening the furnace shells; the redesigned No. 5 reverberatory furnace was placed in operation on July 30. New X-ray spectographic equipment in the Anaconda general laboratory was used for efficient analysis of samples from the Butte mines.

The company received a Government citation from the Presidential Advisory Council on Water and Stream Pollution Control for conservation of water and control of stream pollution by mining and metallurgical wastes. Disposal of metallurgical wastes at the Anaconda reduction works was the subject of two publications during the year.[7]

At yearend, employment at the reduction works totaled approximately 2,200 persons; nearly 1,000 workers were laid off during the year because zinc and phosphate fertilizer production was terminated.

The Anaconda Company annual report to shareholders reported manganese nodule production of 13,180 tons and ferromanganese output of 5,907 tons. White arsenic (arsenic trioxide) was produced as a byproduct of smelting arsenic-containing copper ore at Anaconda.

Gold and silver ores were mined at the Cameron, Eagle Canyon, Gold Coin, Monitor, Silver Chain, Silver Reef, and Champion mines. Major production came from silver ore in the Cameron mine, *Blue-eyed Nellie* district, and from silver ore and tailings at the Champion mine, *Orofino* district.

Limestone mined at Brown's quarry was burned to quicklime for use at The Anaconda Company ore-processing and metallurgical facilities. The ammonium-phosphate plant of The Anaconda Company was dismantled and shipped by J. R. Simplot Co. to a site west of Pocatello, Idaho. The Simplot company had purchased the plant and leased the Conda (Idaho) phosphate rock deposits from Anaconda.

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[7] Day, Frank H. Disposal of Metallurgical Wastes. Min. Cong. J., v. 47, No. 11, November 1961, pp. 52–56.
Mining World. How Anaconda Handles Waste Water. V. 23, No. 1, January 1961, p. 33.

Refractories were made from Cascade County fire clay for the Anaconda operations.

Fallon.—Cabin Creek field, one of eight fields in Fallon County, contributed 4.2 million barrels of crude oil to the county total of 6.6 million barrels. Three gasfields yielded 6.8 billion cubic feet of natural gas; Cedar Creek field contributed 5.5 billion cubic feet of the total.

Fergus.—Two *Warm Springs* district metal mines supplied the total metal-mine production—17 tons of lead ore from the Cave mine yielded 109 ounces of silver, 6,000 pounds of lead, and 1,400 pounds of zinc; gold ore (28 tons) from the Black Bull mine yielded 9 ounces of gold, 19 ounces of silver, and 600 pounds of zinc.

Gypsum was mined near Heath by United States Gypsum Co. and near Hanover by Ideal Cement Co. Locally mined clay was made into heavy clay products by Lewiston Brick & Tile Co.

Flathead.—The May increase to full-capacity production at the Anaconda Aluminum Co. Columbia Falls plant was made possible by the increased consumption at the fabricating units of the company. Remodeling of the ingot-casting facilities at the plant, allowing production of larger sheet ingots and diversified shapes, was completed late in the year.

The only active metal-mining operation in the county was at the Flathead and West Flathead silver property in the *Hig Heaven* mining district.

Gallatin.—Output of nonmetal commodities increased in value; the county continued to be the leading source of nonmetals and ranked fifth among counties having fuel production. The Trident plant of Ideal Cement Co. was the leading mineral industry; enough limestone was produced for use at this plant to make the county the principal source of stone in the State.

Sierra Talc Co. opened a new talc-grinding plant at Three Forks. The ground talc was used by the paint, cosmetics, chemical, pulp and paper, and rubber industries. Ore from the Yellowstone mine in Madison County was cleaned and screened on the site. Some of the output was trucked to the new plant for grinding; crude talc also was shipped to Grand Island, Nebr., and to Los Angeles, Calif., for grinding.

Glacier.—Recovery of crude oil from four fields totaled 589,000 barrels, 67,000 barrels less than in 1960. Output of 1,300 barrels was reported for the Graben Coulee field, a new producing area.

Granite.—Taylor-Knapp Co. and Trout Mining Co. mined 19,343 tons of manganese ore from mines near Philipsburg. Taylor-Knapp shipped metallurgical-grade manganese concentrate containing less than 35 percent manganese to Consolidated Mining & Smelting Co., Trail, British Columbia, and Trout shipped concentrate to The Bunker Hill Co., Kellogg, Idaho, for use as a cell-cleaning agent in electrolytic zinc plants. Ross Hayworth, Philipsburg, shipped a small tonnage of chemical-grade ore to the Taylor-Knapp Co. mill.

Phil Salois of Philipsburg purchased the Mystery mine, a maganese producer during the Government stockpiling program from the estate of Jennie M. Moore.

Precious and base metals came from 19 mines in the county. The Trout Mining Co. Algonquin mine in the *Flint Creek* district, supplied

64 percent of the silver, 53 percent of the copper, 75 percent of the lead, and 77 percent of the zinc produced in the county. Taylor-Knapp Co., the second largest producer, began mining silver-bearing zinc ore in March from the *Flint Creek* district True Fissure mine (Moorlight group). Stoped areas were filled with tailing from the company manganese-milling operation. *Flint Creek* district production also came from the Gold King (gold), Bi-Metallic (zinc), Copper Belle (gold-silver), Cudgie Taylor (silver), Granite Mountain (silver), Keystone (silver), Minnie Lee (silver), Mountain Boy (silver), New Seattle (gold-silver), and Potosi (silver) mines. Other active lode mines were the Black Pine (silver), *Henderson* district; and Moose Trail (gold), *Stony* district. Gold and (or) gold-silver tailings were shipped from the Bi-Metallic, Granite Mountain, Maxville, Black Pine, Rumsey, Moose Lake, and Jefferson properties.

A small quantity of placer gold was recovered by small-scale hand methods in the *Garnet* district.

Jefferson.—Value of metal production declined 32 percent from that of 1960. Production of gold, silver, lead, and zinc decreased; copper output increased 2,000 pounds. The largest silver, lead, and zinc production came from the Lahey Leasing Company Alta-Custer mine in the *Colorado* mining district. The leading individual gold and copper output came from the Montana Gold & Silver company Silver Crescent mine, *Cataract* (*Basin*) district, and the E. E. Lewis Crystal mine lease, respectively. Zinc tailings from the Silver Hill mine yielded 15 tons of lead and more than 32 tons of zinc. Tailings also were shipped from the Alta Custer, Basin Jib, and Comet mines.

Lead and zinc development ore was shipped from the Hope and Bullion mines near Boulder. As part of an exploration and develoment project at the properties, 585 feet of diamond drilling was completed late in 1961.

Other producing properties were the Basin Jib (gold-silver), and Silver Hill (gold-silver) in the *Cataract* (*Basin*) district; Loeber (lead) and Nellie Grant (lead-zinc), *Clancy* (*Lump Gulch*) district; Edelweiss (lead), *Colorado* district; Elkhorn (silver) and Klondyke (gold), *Elkhorn* district; P & P (silver), *Golconda* district; Buffalo-T.J. dumps (gold), Silver Queen (silver), Spirerock (lead), and Sunnyside (gold), *Whitehall* district.

Small quantities of gold were recovered by small-scale hand placer methods in the *Montana City* and *Whitehall* districts.

Judith Basin.—In November, Young-Montana Corp. ceased mining iron ore (magnetite) from the Willow Creek open pit near Stanford. Costs had become excessive because an increasing number of high-sulfur-bearing zones were encountered.

Lewis and Clark.—Lead and zinc recovered from old slag at The Anaconda Company slag-fuming operation, adjacent to the American Smelting and Refining Co. smelter at East Helena, furnished all but $76,391 of the total value ($1,535,041) of the county's metal production. Louis Peura shipped gold-silver tailings from the Peck mill, *Helena* district. The 543 tons of lead ore mined by Helena Minerals Co. at the Sam Gaty mine, *Ten Mile* district, yielded 104 ounces of gold, 13,203 ounces of silver, 7,400 pounds of copper, 222,600 pounds of lead, and 14,000 pounds of zinc. Other producing metal mines were the Pearl (gold), *Blue Cloud* district; Nick & Dick (lead), *Canyon Ferry* district; *Mike Horse* (lead), *Heddleston* district; Silver Cross (gold-silver), *Helena* district; Margurette & Discovery (gold) and Gold Reserve (gold-mill cleanings), *Lincoln* district; Humdinger (gold), *Madison* district; John G. (gold), Little Jimmy (silver), and Woodrow Wilson (gold), *Rimini* (*Vaughn*) district; American Boy (gold-mill cleanings), *Gould-Stemple* district; Rosetta (copper), *Wolf Creek* district; and Happy Jack (gold-silver), *York* district.

Swansea Mines, Inc., completed two diamond-drill holes, totaling 1,252 feet, in exploration of the Carbonate mine in the Heddleston mining district.

Three placer operations—one each in the *Gould-Stemple*, *Helena*, and *Scratch Gravel* districts—produced 34 ounces of gold.

Liberty.—Crude-oil output increased from 39,000 barrels in 1960 to 143,000 barrels. Whitlash, the principal field yielded 92,000 barrels (27,000 barrels in 1960). Natural gas withdrawals rose to 4.1 billion cubic feet, compared with 3.7 billion in 1960.

Lincoln.—Metal output came from two operations in the *Libby* district—A. G. Cook mined gold ore at the Way Up mine, and St. Paul Lead Co. produced several tons of silver ore from the St. Paul and Snowshoe properties. A geologic study was made of northern Lincoln County.[8]

Vermiculite mining near Libby was the principal nonmetal industry. Gerald Kenelty mined a small quantity of barite from a deposit 30 miles southeast of Libby.

Madison.—Value of metal production declined $283,125 to a total of $502,478; approximately 86 percent of the value came from gold output. Gold, silver, and copper production declined 6,350 ounces, 34,265 ounces, and 96,000 pounds, respectively; less than 1,000 pounds of lead and zinc was recovered. Gold ore was mined at the *Renova* district Mayflower and West Mayflower property leased by the Peter Antonioli estate, which ranked 14th among domestic gold producers in 1960. Other production was reported from the Liberty Montana (gold), Mammoth (gold-silver and tailings), Strawberry (gold), Ora (gold), Colorado (gold), Red Pine (gold), Silver Bar-Sparrow (lead), South Fork (gold), Amazon (copper), Liberty (gold), Red Wing (gold), Easton Pacific (gold-silver), El Fleeda (gold-silver), Fairview (copper), and Frank Blair (gold) mines.

The Montana Bureau of Mines and Geology published a report on the *Southern Tidal Wave* mining district.[9]

Talc, the only nonmetal produced, was mined by Sierra Talc Co. (Yellowstone mine) and Tri-State Minerals Co. (Regal and Treasure State mines).

McCone.—Recovery of crude oil from the Richey-Southwest field was 57,000 barrels, 22,000 barrels less than in 1960.

Meagher.—Hoco, Inc., the principal metal producer, mined silver-bearing lead ore from the Cumberland mine in the *Castle Mountain* district. Other production from this district included lead-zinc ore from the Hamilton Mines, Inc., Yellowstone property, gold ore from the A.M. & B. mine, and lead ore from the Maybe mine (Copper State group). Copper ore was shipped from the Copper Duke open pit in the *Musselshell* district. Stream gravel, processed at the Little Joe, Last Chance, and Discovery placers, yielded a small quantity of gold.

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[8] Johns, W. M. Geological Investigations in the Kootenai—Flathead Area, Northwest Montana. No. 3, Northern Lincoln County. Montana Bureau of Mines and Geol. Bull. 23, 1961, 58 pp.

[9] Johns, W. M. Geology and Ore Deposits of the Southern Tidal Wave Mining District, Madison County, Montana. Montana Bureau of Mines and Geol. Bull. 24, 1961, 53 pp.

Mineral.—At midyear, The Bunker Hill Co. obtained a 25-year lease with an option for an additional 25 years on the Nancy Lee Mines, Inc., Nancy Lee property in the *Keystone* district near Superior. Also included in the lease was the 120-ton-a-day flotation mill approximately 7 miles from the mine. General rehabilitation and development work included repair of 2,300 feet of track in the main adit from the portal to the shaft, removal of broken waste rock from the mine, general repair of the shaft, installation of surface equipment, and drifting on the 790 level. Bunker Hill planned to complete a minimum of 400 feet of shaft sinking and 600 feet of drifting.

As a result of the Bunker Hill-Nancy Lee agreement, *Keystone* mining district properties were the subject of renewed interest. Caledonia Silver-Lead Mining Co. and Lookout Mountain Mining & Milling Co., two Kellogg, Idaho, mining firms, and East Coeur d'Alene Mines, Inc., an Idaho corporation organized during the year, obtained control of claims adjacent to the Bunker Hill lease.

Ernie G. Smith, lessor of the Nancy Lee mine for 17 years, mined and milled lead ore before the Bunker Hill lease agreement was completed. A small quantity of silver ore came from the Prosperity mine in the *Iron Mountain* district.

Eleven ounces of gold was produced from the Eclipse and other small-scale hand placer operations in the *Cedar* and *Trout Creek* districts.

The geology of the St. Regis-Superior area was the subject of a report.[10]

Missoula.—Sixteen tons of gold ore was mined at the Nine Mile property in the *Nine Mile* district near Huson. A small quantity of gold was produced in the same district from the Eileen Marsha placer.

Baroid Sales Division, National Lead Co., continued to mine barite and American Crystal Sugar Co. produced lime for use at its refinery.

Musselshell.—Crude-oil recovery from the seven fields in the county was 1.8 million barrels, about 700,000 barrels higher than in 1960. Keg Coulee, a new field in 1960, increased output from 233,000 to 699,000 barrels. No production was reported from the Hawk Creek field.

Mines in the county continued to supply most of the State bituminous coal output (78,000 tons compared with 93,000 tons in 1960).

Phillips.—Gold-silver ore was produced from the *Little Rockies* district Jack Deuce mine, the only active metal-mining operation in the county.

Ruby Gold, Inc., a Nevada corporation, and American Exploration Mining Co., explored claims in the *Little Rockies* district near Zortman under an agreement completed during the year. Ruby Gold, a subsidiary of Gold Reserve Mining Co., Bozeman, controlled claims covering approximately 2,000 acres.

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[10] Campbell, A. B. Geology and Mineral Deposits of the St. Regis-Superior Areas, Mineral County, Montana. Geol. Survey Bull. 1082-I, 1960, 1961, pp. 545-612.

Withdrawals of natural gas from the Bowdoin field, the third most important source of natural gas in the State, totaled 4 billion cubic feet, the same as in 1960.

Powell.—Metal production came from six gold mines in six mining districts. Lode mines supplied 233 ounces of gold and 218 ounces of silver; they were the Hobby Horse, *Big Blackfoot* district; Tip Top, *Emery* (*Zozell*) district; Golden Anchor, *Nigger Hill* district; Cyclone, *Ophir Gulch* district; Lois, *Pioneer* district; and Sunrise-Sweepstake, *Your Name Creek* district. Five placer operations processed 25,807 cubic yards of stream gravel and recovered 67 ounces of gold and 11 ounces of silver.

Montana Phosphate Products Co. and George Relyea supplied most of the phosphate rock produced in the State. Combined output from four mines was slightly less than in 1960. The production was exported mostly to the Consolidated Mining & Smelting Company of Canada, Ltd., plant at Trail, British Columbia, for use in making phosphate fertilizers. Quicklime and hydrated lime were marketed by Elliston Lime Co. Limestone was mined at the company's Elliston quarry.

Ravalli.—Two small gold mines were operated, the Curlew Mining and Exploration Co. Curlew mine in the *Curlew* district and the Larrigon Mining Co. Larrigon mine in the *Hughes Creek* district.

Fluorspar was mined at the Roberts Mining Co. Crystal Mountain open pit and trucked to Darby for processing.

Richland.—The tonnage of lignite produced by Knife River Coal Co. at Sidney increased sharply. Crude-oil recovery from the Brorson and Sidney fields totaled 48,000 barrels. Limestone was calcined to quicklime by Holly Sugar Corp. for use at its refinery.

Roosevelt.—Crude-oil production (2.9 million barrels) from four fields placed the county second as a petroleum source. The Poplar-East, which produced 2.4 million barrels, was the leading field. Recovery from Tule Creek, a new field in 1960, increased from 31,000 to 480,000 barrels.

Rosebud.—Two fields—Sumatra and Hibbard—furnished the 2.5-million-barrel output of crude oil. Production from the Stensvad field, formerly reported in Rosebud County, will be shown under Musselshell-Rosebud Counties because the field was extended into Musselshell County. Output from the Hibbard, a new field in 1960, decreased from 47,000 to 36,000 barrels. Bituminous coal production increased 20 percent.

Sanders.—Metal output decreased sharply because the *Eagle* district Jack Waite mine was closed by American Smelting and Refining Co., lessor of the property since 1934. Production was on a curtailed basis until the mine closed in March. Approximately 25 employees were affected by the shutdown. Other county production came from the Holiday mine (lead-zinc), *Pilgrim* district, and the Raven mine (copper), *Thompson River* district.

Montana-Coeur d'Alene Mines, Inc., completed three diamond-drill holes as part of an exploration program at *Eddy Mountain* mining district claims acquired from State Mining Co.

Sheridan.—Recovery of crude oil from four fields increased to 1 million barrels (707,000 barrels in 1960), mainly because of expanded production from the Dwyer field that began producing in 1960. Production from the Dwyer field was 444,000 barrels, compared with 92,000 barrels in 1960. Lignite was produced at two mines.

Silver Bow.—Output of gold, silver, copper, lead, and zinc supplied 88 percent of the value of all metal produced and 94 percent of the value of precious- and base-metal output in the State. As in other years, production from The Anaconda Company mines dominated metal-output statistics. Ore treated increased from 12.2 to 12.6 million tons; the number of producing operations remained at 11. Output of copper increased, and production of gold, silver, lead, and zinc declined.

No manganese ore was mined in the county; however, ore from The Anaconda Company Emma mine stockpile was processed at Anaconda, Deer Lodge County.

As in 1960, the Butte, Anaconda & Pacific Railway Co. handled a record quantity of ore (13,103,645 tons) during the year. F&S Contracting Co. removed overburden from the Berkeley pit ore body under contract with Anaconda.

The American Chrome Co. optioned property near Butte on which to build a plant to smelt chromite concentrate stockpiled near Nye, Stillwater County, provided a Government contract could be obtained. The Montana Bureau of Mines and Geology made a ground-water study on this property at the request of American Chrome.

A small quantity of gold was produced from a *German Gulch* district placer.

TABLE 14.—Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, in terms of recoverable metals

Year	Mines producing	Material sold or treated (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)
1952–56 (average)	21	6,393	21,518	5,764
1957	19	10,673	27,312	5,069
1958	22	10,745	17,374	3,308
1959	16	8,679	18,615	3,204
1960	11	12,169	21,819	2,918
1961	12	12,635	18,391	2,765
1882–1961	----------	(1)	2,331,000	620,933
	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1952–56 (average)	75,208	14,753	66,126	$78,050
1957	91,393	9,617	43,169	73,328
1958	90,557	5,492	26,580	57,942
1959	65,810	4,456	22,459	50,149
1960	91,754	1,889	4,755	63,980
1961	103,788	435	1,384	65,881
1882–1961	7,645,000	398,000	2,285,000	3,556,056

[1] Data not available.

Summit Valley (Butte) District.—All metal-mine production in the county came from this district. Copper ore from three Anaconda properties—Berkeley pit, Butte Hill (Mountain Con and Steward), and Kelley—furnished most of the State gold, silver, and copper production totals. No lead or zinc ore was mined by the company. The remaining Anaconda company output came from copper precipitates, from silver tailings from the Colorado mine, and from the Emma mine stockpile. The Anaconda Company annual report to shareholders stated:

> Production of copper ores from the mines in Butte was uninterrupted through the year.
>
> Production from block-caving operations of the Kelley mine was reduced from 12,000 tons per operating day to 7,500 tons. Three new ore blocks were brought into production during the year. Increased emphasis was placed on mining in the Berkeley pit, where production averaged 31,310 tons per operating day. The stripping ratio averaged 3.51 tons of waste for each ton of ore mined. Mining of high-grade copper ores from veins continued at the Mountain Con and Steward mines.
>
> Upon completion of the shaft development program in early 1963, connecting haulageways will be installed so that ore production from the lower levels of the Mountain Con, Steward, and Leonard mines can be routed to surface via the central hoisting facility at the Kelley No. 1 shaft.
>
> Installation of the two new, completely automatic, rotary air compressors at the Cora compressor plant was completed.
>
> No zinc or manganese ores were mined during the year because of depressed metal prices.
>
> A reappraisal of low grade disseminated and stock work mineralization adjacent to and including the Kelley orebody has indicated extension of available low-grade ore which can be mined from the Berkeley pit at deeper levels than originally anticipated. Production from this operation will be in addition to underground mining on deep levels of the Mountain Con, Steward, and Leonard mines. High-grade ore development and extensions of deep level ore shoots on the Syndicate, Steward, High Ore, and other veins have added appreciably to Butte's reserves.

A program to reactivate the Leonard mine was begun; however, late in the year this work was discontinued. The company announced that there was still no change in the plan eventually to make the Leonard mine an operating unit in the deep-level mining program.

The only zinc ore mined during the year come from the A. G. Hooper Adelaid and Mat lease. Silver was produced at the Northern Pacific and Tuxedo mines, and gold was produced at the Ryberg mine.

Phosphate rock from the Maiden Rock mine near Melrose was processed to elemental phosphorus at the Victor Chemical Works Silver Bow plant.

Stillwater.—The shrinkage-stope operation at The American Chrome Co. Mouat mine was continued during the first 4 months of the year; ore was drawn from the stopes during the remaining 5 months before the October closure. At yearend, measured, indicated, and inferred ore reserves at the mine were estimated by the company to be in excess of 4 million tons. Approximately 100 workers were released because of the shutdown. A rotating-disk pelletizer was installed in the pilot-smelter charge-preparation room early in the year to pelletize the reductant, flux, and chromite concentrate for charging to the electric smelting furnace.

No precious- or base-metal mining was done in the county.

Toole.—Production of crude oil and natural gas was 678,000 barrels and 55 million cubic feet, respectively. Crude oil recovery from Kevin-Sunburst, the principal oilfield, was 78,000 barrels less than in 1960.

Yellowstone.—Crude oil production from the Mosser and Wolf Springs fields continued to decline; it was 310,000 barrels, 56,000 barrels less than in 1960. Elemental sulfur was recovered from waste gases originating at the Continental Oil Co. and Humble Oil & Refining Co. refineries.

The county was the leading source of sand and gravel in the State. Shale and clay were used, respectively, for making lightweight aggregate and heavy clay products. Limestone was calcined to quicklime for use at The Great Western Sugar Co. refinery near Billings.

Combined Counties.—The following counties have been combined into areas as indicated because a major oilfield or gasfield underlies parts of more than one county and its production cannot be assigned to a single county.

Daniels and Roosevelt.—Recovery of crude oil from the Bredette-North field was only 11,000 barrels, an 18,000-barrel decrease from the 1960 figure.

Dawson, Fallon, Prairie, and Wibaux.—The Pine field output was 5.2 million barrels compared with 5.1 million barrels in 1960. Withdrawals of natural gas from the Pine field were 823 million cubic feet.

Dawson and McCone.—Crude oil output from the Richey field totaled 127,000 barrels, 72,000 barrels less than in 1960.

Garfield and Petroleum.—The Cat Creek field yielded 239,000 barrels of crude oil, an increase of 58,000 barrels over the 1960 figure.

Glacier and Toole.—Recovery of crude oil from the Cut Bank field decreased from 2.1 million barrels in 1960 to 2 million barrels in 1961. The Cut Bank (including Reagan) gasfield (also underlies parts of Pondera County) was the leading natural-gas source in the State. Output totaled 12.4 billion cubic feet, compared with 11.2 billion cubic feet in 1960.

Golden Valley and Stillwater.—Withdrawals of natural gas from the Big Coulee field increased slightly.

Musselshell and Rosebud.—Recovery of crude oil from the Stensvad field declined from 1.9 million barrels in 1960 to 1.5 million barrels.

Pondera and Teton.—The Pondera and Pondera Coulee fields yielded 496,000 barrels of crude oil, compared with 505,000 barrels in 1960.

The Mineral Industry of Nebraska

By Carl L. Bieniewski[1]

❖

THE TOTAL value of mineral production in Nebraska in 1961 was $103.1 million, 1 percent greater than that in 1960, thereby continuing the upward trend and establishing a record value for the 14th consecutive year. Highlighting the year's mineral activity was the rapid and successful development of the Sleepy Hollow oilfield in Red Willow County. By yearend, 187 new producing oil wells drilled in this field had been added to the 19 oil wells already producing; oil pumped totaled 3.7 million barrels.

Mineral fuels represented 73 percent of the total value of mineral production. Value of natural gas liquids and petroleum increased 4, and 2 percent, respectively, in 1961. Because petroleum alone represented 93 percent of the mineral fuels value, the total value of mineral fuels increased only 2 percent. Nonmetals, the remaining 27 percent of the total value of mineral production, increased only 0.4 percent. Increases in value of clays, gem stones, lime, pumice, and stone were offset by decreases for cement and sand and gravel. In the State, 73 of the 93 counties produced minerals; production in 8 counties was valued over $1 million each.

TABLE 1.—Mineral production in Nebraska[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ... thousand short tons	108	$109	146	$148
Gem stones	(2)	4	(2)	5
Natural gas ... million cubic feet	15,258	2,670	15,743	2,629
Petroleum (crude) ... thousand 42-gallon barrels	23,825	68,378	[3] 24,396	[3] 69,529
Sand and gravel ... thousand short tons	10,876	8,746	10,094	8,250
Stone ... do	3,336	5,651	3,622	6,324
Value of items that cannot be disclosed: Cement, lime (1961), natural gas liquids, and pumice		18,384		18,637
Total Nebraska[5]		[4] 101,957		103,060

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Preliminary figure.
[4] Revised figure.
[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

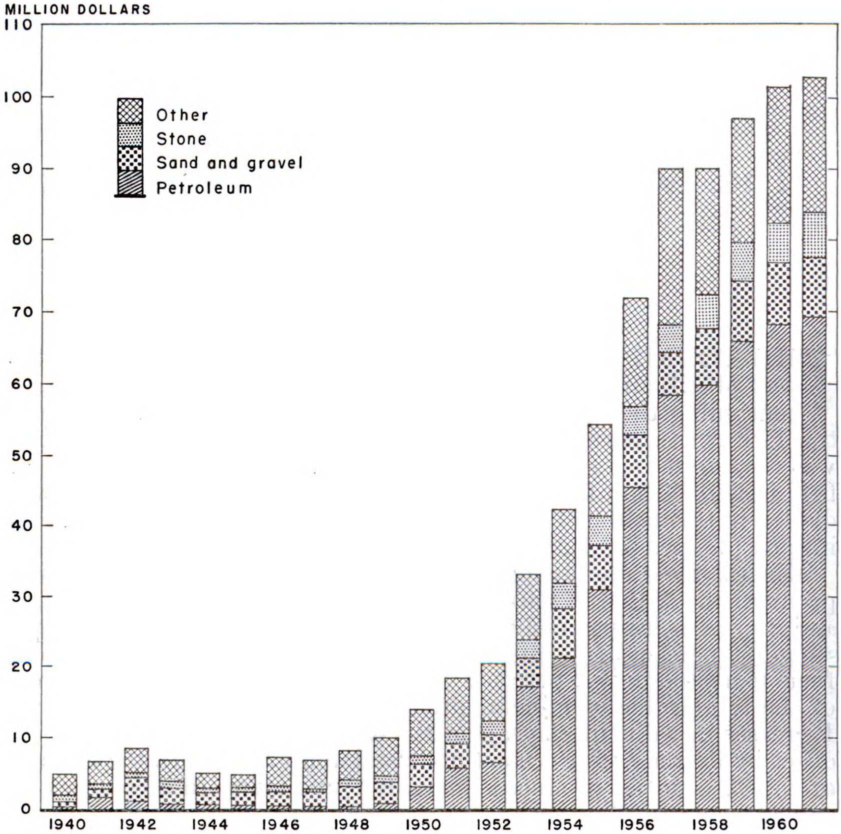

Figure 1.—Value of petroleum, sand and gravel, and stone, and total value of mineral production in Nebraska, 1940–61.

Construction of a 75,000-kw, sodium-cooled, graphite-moderated nuclear power facility near Hallam was completed in December as planned, although the schedule was disrupted in midyear by a labor strike. The plant, built as a cooperative project by the Atomic Energy Commission (AEC) and Consumers Public Power District of Nebraska, was expected to be supplying power to the distribution system of the Consumers Public Power District of Nebraska by mid-1962, after operational testing. The reactor was to extend the technology developed by the Sodium Reactor Experiment (SRE) and to demonstrate the economic and technical practicability of a central-station power plant using a reactor moderated by graphite and with sodium as the heat-transfer fluid.

Employment and Injuries.—Employment and injuries data (final for 1960 and preliminary for 1961) in the mineral industries in Nebraska (excluding the petroleum industry) are shown in table 2.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	Number of operations[2]	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Non-fatal	
1960:						
Sand and gravel plants	189	773	1,500,492		21	14.0
Stone quarries and plants[3]	49	563	1,370,941		17	11.7
Other: Clay and pumice mines and mills and a refinery	9	229	651,128		4	6.1
Total	247	1,565	3,522,561		42	11.9
1961:[4]						
Sand and gravel plants	147	580	1,117,129	1	7	8.2
Stone quarries and plants[3]	72	574	1,294,659		12	9.3
Other: Clay and pumice mines and mills and a refinery	8	214	613,004			
Total	227	1,368	3,024,792	1	19	7.1

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Includes cement plants.
[4] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Natural Gas.—Marketed natural gas production increased 3 percent and value decreased 2 percent in 1961. Gas wells (dry gas) supplied 52 percent, and oil wells (casing head gas) furnished 48 percent of the production. Most of the dry gas came from the Huntsman and West Sidney gasfields in Cheyenne County and from the Big Springs gasfield in Deuel County. The oil-well fields in Banner, Cheyenne, and Kimball Counties were the source of the casing head gas.

Natural Gas Liquids.—The total output of natural gasoline, butane, and propane recovered at five natural gasoline plants was 11 percent greater than that in 1960. The daily throughput of the plants—two in Cheyenne County and one each in Banner, Deuel, and Kimball Counties—averaged 63.7 million cubic feet of natural gas.

Petroleum.—Crude petroleum production surpassed that of 1960 by 500,000 barrels, thereby maintaining the steady growth that started in 1948. The value of petroleum was 67 percent of total value of mineral production in the State. Quantity and value of petroleum production were both 2 percent greater than in 1960. For the first time, petroleum was produced in Dundy, Frontier, and Furnas Counties. Thirteen counties, the most ever reported, produced oil.

Extensive exploration and development was conducted along the Cambridge Arch, southeast of the Denver-Julesburg basin, because of the successful development of the Sleepy Hollow and Ackman fields along the arch. A discovery in Lincoln County extended the area of potential oil reserves farther to the northwest along the west side of the arch.

The Sleepy Hollow field, in Red Willow County, was developed rapidly, and became the largest producer in the State. At yearend 20 percent of the oil produced in Nebraska was coming from this field.

Activity in the Denver-Julesburg basin was relatively quiet compared with that along the Cambridge Arch. However, output from several small fields developed in the basin in 1960 helped offset the production losses from some of the older fields in the basin.

TABLE 3.—Crude petroleum production, by counties

(Thousand barrels)

County	1960	1961[1]	Principal fields in 1961 in order of production
Banner	7,771	5,359	Willson Ranch, Singleton, Barrett, Raymond, Vedene, Vowers, Brinkerhoff.
Cheyenne	3,822	3,556	Cook, West Frei, Doran, Spearow, Dorman, Frei.
Dundy		31	Pierce Lake, Indian Creek.
Frontier		2	Spring Creek.
Furnas		6	Beaver Creek.
Garden	6	10	Richards.
Harlan		110	South Alma.
Hitchcock	294	261	Reiher.
Kimball	10,372	8,978	Sloss, Jacinto, Enders, Kimball, Russell, Southwest Potter.
Morrill	757	1,232	Waitman, Lane, Lindberg, Olsen, Graff.
Red Willow	553	4,624	Sleepy Hallow, Ackman, Silver Creek.
Richardson	153	181	Dawson, Falls City.
Scotts Bluff	97	46	Vessels, Roubadeau.
Total	23,825	24,396	

[1] Preliminary figures.

TABLE 4.—Wildcat- and development-well completions in 1961, by counties

County	Crude	Dry	Total	Footage
Wildcat:				
Adams		2	2	8,200
Banner	4	69	73	401,500
Buffalo		1	1	4,200
Chase		7	7	35,900
Cheyenne	5	50	55	279,000
Custer		7	7	22,500
Dawes		1	1	3,600
Dawson		4	4	15,000
Deuel		2	2	7,300
Dundy	5	8	13	65,700
Franklin		3	3	13,300
Frontier	1	37	38	146,200
Furnas	1	33	34	120,400
Garden		1	1	3,600
Gosper		5	5	18,400
Greeley		2	2	6,700
Harlan	1	10	11	41,300
Hayes		20	20	91,000
Hitchcock	2	10	12	54,400
Holt		2	2	5,200
Hooker		1	1	4,200
Howard		2	2	7,000
Kimball	7	63	70	459,200
Knox		1	1	1,200
Lincoln	1	14	15	64,100
Merrick		1	1	3,200
Morrill		26	26	122,400
Perkins		5	5	25,100
Wildcat—Con.				
Phelps		2	2	8,300
Red Willow	8	95	103	380,200
Richardson		1	1	2,400
Scotts Bluff		5	5	25,700
Sheridan		1	1	3,700
Webster		1	1	4,100
Wheeler		2	2	6,600
Total	35	494	529	2,460,800
Development:				
Banner	18	29	47	275,700
Cheyenne[2]	17	26	45	234,900
Dundy	2	2	4	18,200
Furnas		1	1	3,500
Harlan	18	5	23	79,800
Hitchcock	3	4	7	31,800
Kimball	17	53	70	453,600
Lincoln		1	1	4,500
Morrill	31	9	40	188,700
Red Willow	214	[1] 23	237	846,900
Scotts Bluff		1	1	5,700
Total	320	[1] 154	476	2,143,300
Total all drilling	355	[1] 648	1,005	4,604,100

[1] Includes 1 service-well completion.
[2] 2 development gas wells were completed in Cheyenne.

Source: Oil and Gas Journal.

A record total of 1,005 completions was made during the year; of these completions, 476 were development wells, and 529 were wildcat wells. This established a new record for wildcat wells completed in any 1 year in the State. The success ratio for the wildcat wells was

1:15. The number of rigs operating at one time ranged from 13 to 42. The depth of wells drilled averaged 4,503 feet for development wells and 4,652 feet for wildcat wells. Total expenditures were $72 million, of which drilling expenditures were $30 million. The average cost of a producing well was $40,000; that of a dry hole, $14,000. At yearend proved reserves (primary recovery) had increased 21.5 million barrels. Overall cost for each barrel of new oil found during the year was $1.56. The State was successful in leasing acreage; only twice during the year it failed to receive bonus bids on all tracts offered at the regular monthly sales. A tract northwest of the Sleepy Hollow field was acquired for $84 per acre, one of the highest bonuses ever paid for State-owned land.

NONMETALS

Cement.—Shipments of portland and masonry cements from plants at Superior (Ideal Cement Co.) and Louisville (Ash Grove Lime & Portland Cement Co.) were only 1 percent less than in 1960. Prices of portland and masonry cements averaged $3.43 and $4.40 per barrel (376 pounds), respectively, compared with $3.41 and $4.38 per barrel in 1960. About three-fourths of the cement was delivered in Nebraska, and the remainder was sent to nearby States. Nearly all the basic raw materials used in manufacturing cement were mined by the companies for their own use; additives were purchased. Ready-mixed concrete companies consumed the greatest quantity of portland cement. Other leading consumers were highway contractors, building material dealers, and concrete product manufacturers.

Power consumption at the cement plants was 75.8 million kwhr, an increase of 4.2 million kwhr or 6 percent over that in 1960. A 5-percent production increase at the two plants accounted for the added power consumption. Annual average operational time for the eight kilns at the plants was 340 days.

Clays.—Production of clay increased 35 percent. The clay was produced and used to manufacture cement, brick, and tile by Ash Grove Lime & Portland Cement Co., Endicott Clay Products, Omaha Brick Works, Western Brick & Supply Co., and Yankee Hill Brick Manufacturing Co. The clay pits of these companies were in five southeastern counties.

Gem Stones.—Petrified wood—by far the leading gem material collected by rock dealers, gem societies, and individual collectors—was one-half of the value of all gem materials collected. Also collected were specimens of agate, calcite, chalcedony, jasper, galena, sphalerite, and dolomite. Gem material was reportedly found in Dawes, Garden, Hall, Knox, Sheridan, and Sioux Counties.

Lime.—Quicklime was produced and then used in sugar refining at the Gering, Mitchell, Scottsbluff, and Bayard plants of The Great Western Sugar Co. and the Grand Island plant of American Crystal Sugar Co. The two pot and five shaft kilns used in making the lime burned coke for fuel.

Perlite.—Western Mineral Products Co. processed crude perlite from deposits in New Mexico and Nevada at its plant in Omaha. The expanded perlite was used as a concrete aggregate and in making building plaster.

Pumice.—LaRue-Axtell Pumice Co. ground and sized crude pumice at its plant at Callaway in Custer County mainly for use as a cleansing and scouring compound.

Sand and Gravel.—Production of sand and gravel, the third most valuable commodity, represented 8 percent of the total value of mineral production in the State. Tonnage and value were 7 and 6 percent, respectively, less than in 1960. The quantity of sand and gravel used in building construction increased 366,000 tons, but the quantity used in road construction decreased about 1 million tons. Road and building construction consumed 53 and 41 percent, respectively, of the sand and gravel production. The remainder was used for railroad ballast, fill, industrial, and miscellaneous purposes.

TABLE 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Construction sand:				
Building	1,821	$1,478	2,005	$1,747
Paving	780	598	851	716
Railroad ballast	18	10	(1)	(2)
Fill	170	95	251	119
Other	61	24	9	8
Industrial:				
Engine	1	(2)	----------	----------
Other	----------	----------	(3)	(3)
Total sand	2,851	2,205	3,116	2,590
Construction gravel:				
Building	1,905	1,620	2,145	1,809
Paving	5,005	4,113	3,617	2,903
Fill	6	5	12	8
Other	6	6	83	58
Miscellaneous gravel	341	224	126	108
Total gravel	7,263	5,968	5,983	4,886
Total sand and gravel	10,114	8,173	9,099	7,476
Government-and-contractor operations:				
Sand:				
Building	22	11	(1)	(2)
Paving	41	17	227	110
Fill	----------	----------	70	14
Total sand	63	28	297	124
Gravel:				
Building	62	31	26	25
Paving	552	489	616	569
Fill	85	25	56	56
Total gravel	699	545	698	650
Total sand and gravel	762	573	995	774
All operations:				
Sand	2,914	2,233	3,413	2,714
Gravel	7,962	6,513	6,681	5,536
Grand total	10,876	8,746	10,094	8,250

[1] Less than 500 short tons.
[2] Less than $500.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Other" construction sand.

Sand and gravel was produced in 61 of the 93 counties. Ninety percent of the production and 145 of the 180 operations were classified as commercial. Production from the other 35 operations was used only on projects sponsored by Federal, State, county, or municipal agency. Commercial operators who produced over 100,000 tons during the year were Behrens Construction Co., Brockman Sand & Gravel Co., Central Sand & Gravel Co., Christensen Sand & Gravel Co., Consolidated Sand & Gravel Co., Elkhorn Construction Co., Gayman Sand and Gravel, H & M Equipment Co., Inc., Hartford Sand & Gravel Co., Kirkpatrick Sand & Gravel, Inc., Lincoln Sand & Gravel Co., Luther & Maddox, Lyman-Richey Sand & Gravel Corp., McCann Sand & Gravel Co., Paul Sawyer Sand & Gravel Co., Western Sand & Gravel Co., and Wolf Sand & Gravel Co.

The Bureau of Public Roads, in a report[2] on the Federal-Aid highway programs, showed that at the end of the year 70 miles of roads was open to traffic, 234 miles was underway (either in the construction, engineering, or right-of-way phase), and 187 miles was to be started for the 491 miles of the Interstate and Defense Highway System designated for Nebraska. Of the 70 miles open to traffic at yearend, 29 miles was completed in 1961. Because the Bureau of Public Roads changed its method of reporting the progress of this system during 1960, a comparable figure of completed road during 1960 was not available. Under the Federal-Aid Primary and Secondary Highway (ABC) Systems, 359 miles of roads was completed in 1961, and 1,324 miles was under construction at the end of the year; the corresponding figures for 1960 were 694 and 897, respectively.

Stone.—Stone sold or used increased 9 percent in quantity and 12 percent in value over 1960. Except for 840 tons of sandstone, all of the stone output was limestone, mainly used as an aggregate in concrete and as road-base material; 125,000 tons less was produced for these uses than in 1960. Cement manufacturing consumed 7 percent more limestone than in 1960; that for riprap increased by 300,000 tons. Sandstone also was used for riprap. Most of the riprap went into stabilizing the banks of the Missouri River.

Limestone also was used as a refractory (dolomite), filler (in asphalt and rubber), and a soil conditioner. Major stone producers (100,000 tons or more of output) were Ash Grove Lime & Portland Cement Co., Fort Calhoun Stone Co., Heebner Quarries, Hopper Bros. Quarries, J. A. Tobin Construction Co., Nelson Quarries, Inc., United Mineral Products Co., and Stone Products, Inc. Other producers were Ag-Lime Sand Gravel Co., Claude N. Case, Colaska Production Co., Grosshans Peterson, Haith's Lime & Rock Quarry, J. D. Schwarck Quarries, Inc., Welsh Stone Co., Inc., Welp & McCarten, Inc., and Wymore Lime & Rock. Cass, Nemaha, Sarpy, and Washington Counties furnished 92 percent of the stone production.

Talc.—The Sierra Talc Co. plant at Grand Island processed crude talc from deposits in California and Montana. Except for a small quantity exported, the ground talc was used in manufacturing ceramics, paint, paper, rubber, textiles, and toilet preparations.

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[2] Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program. Dec. 31, 1960, press release BPR 62-4, Feb. 7, 1962.

Vermiculite.—The Western Mineral Products Co. plant at Omaha processed crude vermiculite from mines in Montana. The exfoliated vermiculite was used for loose-fill insulation, for litter in stock pens, and as an aggregate in plaster and acoustical materials.

METALS

Nebraska had no record of metal production. The American Smelting and Refining Co. (Asarco) operated its lead refinery at Omaha. Lead bullion from smelters in other States and lead-containing materials from foreign sources were processed at the plant.

REVIEW BY COUNTIES

Only those counties that produced substantial quantities of minerals or had significant mineral activity during the year are discussed; table 6 contains additional details.

Banner.—Producing 15 percent of the total value of mineral production in the State, Banner County ranked third even though the quantity of oil produced was 31 percent below that of 1960. However, enough oil was produced during the year so that the county again ranked second in output.

TABLE 6.—Value of mineral production in Nebraska, by counties [1]

County	1960	1961 [2]	Minerals produced in 1961 in order of value
Adams	$38,100	$30,500	Sand and gravel.
Antelope	17,700	77,200	Do.
Banner [3]	22,342,500	15,306,400	Petroleum, sand and gravel.
Boone	(4)	(4)	Sand and gravel.
Boyd	15,200	(4)	Do.
Brown	(4)	28,700	Do.
Buffalo	241,100	213,800	Do.
Butler	237,600	73,500	Do.
Cass	16,458,417	16,506,662	Cement, stone, sand and gravel, clays.
Cedar	168,400	137,900	Sand and gravel.
Cherry	----------	3,396	Sand and gravel, stone.
Cheyenne [3]	10,972,500	10,135,000	Petroleum.
Clay	122,800	53,300	Sand and gravel.
Colfax	62,200	69,800	Do.
Cuming	189,100	110,100	Do.
Custer	(4)	100,730	Sand and gravel, pumice.
Dawes	155	3,680	Clays, gem stones.
Dawson	193,250	155,400	Sand and gravel.
Deuel [3]	----------	----------	
Dixon	69,042	178,776	Sand and gravel, stone.
Dodge	912,000	870,200	Sand and gravel.
Douglas	823,820	856,800	Do.
Dundy	----------	88,000	Petroleum.
Fillmore	(4)	56,200	Sand and gravel.
Franklin	(4)	51,230	Sand and gravel, stone.
Frontier	----------	25,900	Sand and gravel, petroleum.
Furnas	(4)	92,600	Do.
Gage	(4)	222,115	Sand and gravel, stone.
Garden	82,400	59,275	Sand and gravel, petroleum, gem stones.
Gosper	----------	500	Sand and gravel.
Greeley	----------	15,600	Do.
Hall	545,700	438,683	Sand and gravel, lime, gem stones.
Hamilton	61,200	57,400	Sand and gravel.
Harlan	----------	314,000	Petroleum.
Hayes	(4)	(4)	Sand and gravel.
Hitchcock	872,600	782,700	Petroleum, sand and gravel.
Holt	67,300	16,000	Sand and gravel.
Jefferson	226,634	206,603	Sand and gravel, clays.
Kearney	95,800	94,200	Sand and gravel.
Keith	45,500	50,200	Do.
Kimball [3]	[5] 29,807,400	25,587,000	Petroleum.
Knox	235,800	137,200	Sand and gravel, gem stones.

See footnotes at end of table.

TABLE 6.—Value of mineral production in Nebraska, by counties[1]—Continued

County	1960	1961 [2]	Minerals produced in 1961 in order of value
Lancaster	(4)	$280,602	Stone, sand and gravel, clays.
Lincoln	$150,805	140,900	Sand and gravel.
Loup	31,000	52,400	Do.
Madison	161,800	155,200	Do.
Merrick	(4)	30,100	Do.
Morrill	2,268,300	3,629,300	Petroleum, sand and gravel, lime.
Nance	67,350	16,800	Sand and gravel.
Nemaha	(4)	(4)	Stone.
Nuckolls	(4)	(4)	Cement, sand and gravel.
Otoe	70,200	79,355	Stone, clays.
Pawnee	304,200	(4)	Stone.
Perkins	12,200	21,000	Sand and gravel.
Phelps	83,500	44,500	Do.
Pierce	110,700	57,300	Do.
Platte	353,600	875,200	Do.
Polk	(4)	---	
Red Willow	1,654,700	13,259,400	Petroleum, sand and gravel.
Richardson	572,638	597,187	Petroleum, sand and gravel, stone.
Saline	84,200	38,000	Sand and gravel.
Sarpy	(4)	1,088,286	Sand and gravel, stone.
Saunders	(4)	168,900	Sand and gravel.
Scotts Bluff	344,900	405,400	Lime, petroleum, sand and gravel.
Seward	(4)	(4)	Stone.
Sheridan	1,800	2,800	Sand and gravel, gem stones.
Sherman	21,800	---	
Sioux	10,360	(4)	Sand and gravel, gem stones.
Stanton	(4)	70,400	Sand and gravel.
Thayer	176,800	96,100	Do.
Thurston	---	(4)	Stone.
Valley	41,700	31,300	Sand and gravel.
Washington	(4)	(4)	Stone.
Webster	(4)	(4)	Sand and gravel, stone.
York	(4)	35,800	Sand and gravel.
Undistributed [5]	[6] 12,515,902	11,139,032	
Total [7]	[6] 101,957,000	103,060,000	

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[1] The following counties are not listed because no production was reported: Arthur, Blaine, Box Butte, Burt, Chase, Dakota, Garfield, Grant, Hooker, Howard, Johnson, Keya Paha, Logan, McPherson, Rock, Thomas, Wayne, Wheeler.

[2] Value of petroleum is preliminary.

[3] Excludes natural gas and natural gas liquids.

[4] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[5] Includes natural gas, natural gas liquids, some sand and gravel (1961) and gem stones that cannot be assigned to specific counties, and values indicated by footnote 4.

[6] Revised figure.

[7] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement.

Fifty-eight fields with 373 operating wells produced 5.4 million barrels of oil. In 1960, the two major fields, Willson Ranch and Singleton, each had produced over 1 million barrels; in 1961, however, they produced only 847,000 and 786,000 barrels of oil, respectively. Barrett field, yielding about 450,000 barrels of oil, ranked third. The Brinkerhoff, Raymond, Vedene, and Vowers fields each produced between 200,000 and 300,000 barrels. The West Downer, Edwards, Grant, Harrisburg, Kenmac, and Ludden fields produced between 100,000 and 200,000 barrels of oil, each. Nine fields produced between 50,000 and 100,000 barrels.

The Burnett Draw and Vogt fields had no production in 1961; their total 1960 production was only 55,800 barrels. Decreases of more than 500,000 barrels, each, were reported for the Singleton and Willson Ranch fields. Other fields declining significantly in output were the Harrisburg, Kenmac, Lewis, Ludden, Panam, and Van Pelt (between 100,000 and 300,000 barrels each) and the Brinkerhoff, Davis, Edwards, and McDaniel (between 50,000 and 100,000 barrels each).

The Grant and West Downer fields each increased output more than 100,000 barrels over that of 1960. Two fields, Barrett and Vowers, increased output more than 50,000 barrels. Two fields discovered in 1961 produced a total of about 44,000 barrels.

Exploratory drilling was virtually the same as in 1960. Only one county, Red Willow, completed more wildcat wells during 1961. However, Banner County's four successful wildcat wells resulted in only two new fields because two of the reported discoveries were later combined with older fields. Initially the Mallard field discovery well (sec. 10, T. 19 N., R. 55 W.) produced 420 barrels per day, the highest producing discovery in the State in 1961. This well was also the only one in the State not completed on pump. The producing zone was in the D sandstone from 5,306 to 5,307 feet. The J sandstone, encountered at 5,457 feet, was not productive. A southwest offset produced 460 barrels per day, but offsets to the south, east, and west and stepouts to the north and southwest were failures. The discovery well of the other new field, Omega (sec. 11, T. 17 N., R. 55 W.), pumped 223 barrels of oil and 70 barrels of water, and flowed 557,000 cubic feet of gas per day. The J sandstone was the producing zone, from 6,205 to 6,209 feet. Offsets to the north and northwest were successful, but a stepout one-half mile to the north was a failure. One successful wildcat well, at first considered a discovery, was combined with the Mead field; another—about halfway between the Monte and Soule fields, which are only about a mile apart—was probably an extension of one of these fields.

Casing head gas from some of the oilfields in Banner County was processed at the Banner County natural gasoline plant of Antelope Gas Products Co.

The Banner County Highway Department and the Scotts Bluff County Highway Department produced paving sand and gravel for road construction from deposits in Banner County.

Cass.—Sixteen percent of the total mineral value in the State was produced in Cass County, which ranked second in value of mineral production. The county was the leading producer of cement, clay, and stone. Portland and masonry cements were manufactured at the Louisville plant of Ash Grove Lime & Portland Cement Co. Cement rock (limestone) and shale for manufacturing cement were mined by the company from deposits near the plant. Limestone was produced by Heebner Quarries, Hopper Bros. Quarries, J. A. Tobin Construction Co., United Mineral Products Co., Welp & McCarten, Inc., and Welsh Stone Co., Inc. The stone was used mainly for riprap and road material. Some stone was used as a refractory material and for agricultural purposes. In output of sand and gravel the county ranked fifth. Lyman-Richey Sand & Gravel Corp. (Plant 5–6) and Western Sand & Gravel Co. (Cedar Creek and South Bend plants) supplied all the sand and gravel produced. It was used either for building or paving.

Cheyenne.—The county furnished 10 percent of the value of mineral production and ranked fifth. Value came entirely from petroleum. Cheyenne County declined from third to fourth in oil production because of the increase in oil production in Red Willow County.

Sixty-three fields with 315 operating wells produced 3.6 million barrels of oil, 7 percent below production in 1960. Cook field, the largest in the county, produced slightly over 400,000 barrels. The West Frei field (a 1960 discovery) and the Doran-Farms Unitized fields produced about 325,000 and 230,000 barrels, respectively. Fields which produced between 100,000 and 200,000 barrels of oil were the Dorman, Frei, Johnson, Juelfs, Reimer, Spearow, and North Faro (a new field). Fourteen other fields each produced between 50,000 and 100,000 barrels.

Fields which produced in 1960 but which did not report production in 1961 were the Chandler, Dalton, Henry, Herboldsheimer, Marlowe, Neimann, Nelson, Shorts, and Southwest Sidney; the 1960 total production for these fields was about 50,000 barrels.

The Cook and Ittner fields each decreased more than 100,000 barrels below production in 1960. Production decreases between 50,000 and 100,000 barrels were noted in the Fleming, Juelfs, Murfin, and Rohling fields.

Substantial increases in petroleum production over 1960 were reported for only two fields: Faro, 52,000 barrels and West Frei, 323,000 barrels. The West Frei field was not discovered until 1960 and for that year produced only about 1,000 barrels. Of the five new fields discovered in 1961, only three—Emerald, Pecos, and North Faro—reported production. Of the 150,000 barrels produced in these three fields, North Faro supplied 93 percent.

The success ratio for wildcat wells was 1:11; exploratory drilling discovered five new fields. The North Faro field discovery well (sec. 36, T. 17 N., R. 50 W.) pumped 216 barrels per day from the J sandstone between 4,721 and 4,743 feet. Offset wells to the north, northeast, and south were successful; a well to the east and a well one-half mile to the south were failures. Also, an offset well drilled north of the Faro field was a failure; thus two dry holes separated the North Faro and Faro fields, which were only about three-quarters of a mile apart. The Emerald field discovery well (sec. 8, T. 14 N., R. 52 W.) pumped 115 barrels of oil and 146 barrels of water per day. The producing zone was in the J sandstone between 5,267 and 5,274 feet. The only offset (an east one) was a failure. The Pecos field discovery well (sec. 5, T. 14 N., R. 50 W.) pumped 86 barrels of oil plus 42 percent water. The producing zone was in the D sandstone from 4,803 to 4,808 feet. No offsets were drilled during the year. The Southwest Sidney area discovery well (sec. 3, T. 12 N., R. 51 W.) pumped 45 barrels of oil plus 80 percent water per day. The producing zone was the J sandstone between 5,065 to 5,066 feet. No offsets were drilled during the year. The Liberty field discovery well (sec. 24, T. 13 N., R. 53 W.) pumped 60 barrels of oil and 40 barrels of water in 11 hours from the D sandstone between 5,524 and 5,526 feet. Three months later, the reworked well produced from the J sandstone between 5,639 and 5,643 feet. Initially 147 barrels of oil was pumped from this zone. An offset to the west and a stepout to the southeast were failures.

The two Ohio Oil Co. natural gasoline plants near Sidney recovered natural gasoline, butane, and propane from natural gas obtained from oilfields in Banner and Cheyenne Counties and from gasfields in Cheyenne County.

Deuel.—The Deuel compressor and refrigeration-absorption plant of Kansas-Nebraska Natural Gas Co., Inc., at Big Springs processed natural gas from the nearby Big Springs gasfield. The daily throughput of the plant was 32.7 million cubic feet of gas, which was 93 percent of capacity. Products recovered were propane, butane, and natural gasoline. The residual gas was marketed through company-owned pipelines to consumers in central Nebraska and northeastern Colorado.

Dodge.—Although sand and gravel was the only commodity produced, the county was 10th in value of mineral production. The county was the leading sand and gravel producer. Christensen Sand & Gravel Co., Lincoln Sand & Gravel Co., Lux Sand & Gravel Co., and Lyman-Richey Sand & Gravel Corp. operated plants. Nearly all of the sand and gravel was used for building or paving. About 2 percent was used for fill sand, making foundry cores, and miscellaneous purposes.

Douglas.—The only mineral production reported was sand and gravel; the county ranked third in sand and gravel production. Plants were operated by Acme Sand & Gravel Co., Hartford Sand & Gravel Co., Lyman-Richey Sand & Gravel Corp. (two plants), McCann Sand & Gravel Co., and Nebraska Aggregates. The output was used for building and road construction and for fill material. Perlite and vermiculite from out-of-State deposits were processed at the Western Mineral Products Co. plant in Omaha. The lead refinery of Asarco at Omaha operated throughout the year. Refined lead, antimonial lead, and some byproducts were obtained from the lead bullion shipped from smelters outside the State.

Dundy.—Petroleum was produced in the county for the first time. The Pierce Lake field, discovered in 1960, and three of four new fields found in 1961 produced during the year. None of the fields produced over 13,000 barrels.

Five wildcat wells were successfully completed; four were new fields, and one was a discovery of a new producing horizon (Admire formation from 3,790 to 3,796 feet) in the Pierce Lake field. The Highland field discovery well (sec. 31, T. 3 N., R. 36 W.) pumped 95 barrels of oil plus 4 percent water per day. The producing zone was the Foraker formation between 3,824 and 3,830 feet. An offset to the southeast was unsuccessful. The discovery wells of the other three new fields lay within a 3- by 1-mile area about 3 miles northwest of the Pierce Lake field. No offsets from the three discovery wells were drilled in 1961. The Rock Creek field discovery well (sec. 29, T. 3 N., R. 37 W.) pumped 68 barrels of oil per day from the Lansing-Kansas City formation between 4,216 and 4,387 feet. Initial production pumped from the East Indian Creek discovery well (sec. 31, T. 3 N., R. 37 W.) was 35 barrels of oil per day from the Lansing-Kansas City formation between 4,238 and 4,442 feet. There was no production from this well in 1961. The Indian Creek field discovery well (sec. 36, T. 3 N., R. 38 W.) pumped 47 barrels of oil from the Lansing-Kansas City formation between 4,248 and 4,304 feet. The Precambrian was encountered at 5,064 feet.

Frontier.—Oil was discovered in the county in 1961. Thirty-eight wildcat wells were completed during the year, but only one resulted in a discovery. The discovery well (sec. 33, T. 6 N., R. 30 W.) of the Spring Creek field pumped 12 barrels of oil and 12 barrels of water per day from the Basal sand between 4,230 and 4,240 feet; about 1,500 barrels of oil was produced. The Precambrian was encountered at 4,246 feet. No offsets were completed during the year. Worley Sand & Gravel produced building sand and paving gravel.

Furnas.—Oil was discovered in Furnas County during the year. One of the 34 wildcat wells completed was successful. The Beaver Creek field discovery well (sec. 17, T. 2 N., R. 25 W.) pumped 131 barrels of oil. The producing zone was the Reagan formation from 3,391 to 3,394 feet. The Precambrian was encountered at 3,418 feet. A southwest offset was a failure. Production from the discovery well was 5,500 barrels of oil.

Two operators, Herman Obering and Weverka Gravel Co., produced sand and gravel, used mostly for paving sand and gravel; some was used either as building sand or fill sand.

Harlan.—For the first time since 1958, oil was produced in Harlan County. Production came from 22 wells in 4 fields, including 1 new field, Prairie Dog Creek. The Alma South field produced about 90 percent of the output. The two other fields were the Bantam and Battin. The Prairie Dog Creek field discovery well (sec. 14, T. 1 N., R. 18 W.) was the farthest eastern successful exploratory well completed in the State for the year. The producing zone was the Lansing-Kansas City formation from 3,366 to 3,470 feet, from which 40 barrels of oil was pumped. South and southwest offsets completed were successful.

Hitchcock.—Value of mineral production was $90,000 less than in 1960. Value of oil produced was $100,000 less, but was partly offset by an increase in the value of sand and gravel produced. Six fields with 37 operating wells supplied the oil; the Reiher field furnished about 95 percent of the production.

Three wildcat wells were successful. The Eagle field discovery well (sec. 27, T. 2 N., R. 32 W.) pumped 50 barrels of oil per day from the Lansing-Kansas City formation between 3,762 and 3,763 feet. Two wells drilled 1½ miles to the north and southeast were failures. Initially the Driftwood field discovery well (sec. 31, T. 1 N., R. 33 W.) produced 98 barrels of oil and 42 barrels of water per day on pump from the Lansing-Kansas City formation between 4,021 and 4,119 feet. No offsets were drilled. The Wildhorse Canyon field discovery well (sec. 28, T. 1 N., R. 33 W.) pumped 50 barrels of oil per day from the Lansing-Kansas City formation between 3,936 and 4,066 feet. No offsets were drilled.

Buzzell Gravel Co. and Daisy Trask Gravel produced sand and gravel for building and paving.

Kimball.—The county still led in production of petroleum, and value of minerals, even though the quantity of oil produced was 14 percent less than in 1960, and no sand and gravel was produced in 1961. The county contributed one-quarter of the total value of mineral production in the State.

Oil production was reported from 121 fields, of which 4 were new fields and 1 was a field that had been idle since 1955. A total of 699 wells was operated in the 121 fields. About 1.3 million barrels was produced from the Sloss field, ranking second in production in the State and the only field in the county producing more than 1 million barrels. The Enders and Jacinto fields each produced more than 500,000 barrels. The Brook, Kimball, Russell, and Southwest Potter fields each produced between 400,000 and 500,000 barrels. Fields that produced between 200,000 and 300,000 barrels were Griffith, Hill, Ostgren, and Vavra (idle since 1955). Producing between 100,000 and 200,000 barrels were the Allchin, Cornils, Durham, Fernquist, Gehrke, Heidemann, Long, Riggs, Simpson, and Torgeson fields. Thirteen fields produced between 50,000 and 100,000 each.

Production from four new fields—Otter, Pintail, Sulphide, and White House—totaled 50,000 barrels.

The Jacinto field produced about 400,000 more barrels of oil than in 1960. The Vavra field produced about 250,000 barrels more oil than in 1955, its last year of production. The Hill and Kimball fields each produced between 100,000 and 200,000 barrels more oil than in 1960. Production from the Hoffman and Painter fields increased more than 50,000 but less than 100,000 barrels.

The Brook and Sloss fields each decreased in production between 200,000 and 300,000 barrels. Declines of between 100,000 and 200,000 barrels were reported from the Bartow, Gehrke, Griffith, Nichols, Simpson, and Southwest Potter fields. The Fernquist, Heidemann, Long, Ostgren, and Vrtatko fields decreased between 50,000 and 100,000 barrels.

Fields which produced in 1960 but not in 1961 were the Ansel State, Beard, Dolcater, Kauffman, McDowell State, and Steele. Production from these fields totaled about 75,000 barrels of oil in 1960.

Exploratory drilling declined; there were only 70 wildcat completions, compared with 92 in 1960. Six discoveries were made; however, an unnamed J sandstone discovery was noncommercial. Each of the discoveries was no more than 1½ miles from a producing field. The White House field discovery well (sec. 2, T. 13 N., R. 58 W.) pumped 150 barrels of oil per day from the J sandstone formation. At 7,250 feet, the pipe was notched for extracting the oil. Three offsets were failures. The only new field (excluding the noncommercial discovery) that did not produce was the Vulcan. Initial production pumped from the discovery well (sec. 20, T. 14 N., R. 55 W.) was 113 barrels of oil per day (the amount of basic sediment and water was unreported) from the D sandstone between 6,242 and 6,246 feet. No offsets were drilled. The Pintail field discovery well (sec. 29, T. 14 N., R. 54 W.) pumped 63 barrels of oil per day from the J sandstone at 6,127 feet. A southeast offset was unsuccessful. The Otter field discovery well (sec. 6, T. 15 N., R. 55 W.) pumped 102 barrels of oil and 25 barrels of water per day. The producing zone was the J sandstone from 6,449 to 6,455 feet. A stepout one-half mile to the east was a failure. The leading producer of the new fields was the Sulphide. Initial production from the discovery well (sec. 28, T. 15 N., R. 55 W.) was 150 barrels of oil per day. The producing zone was in the J sandstone between 6,146.5 and 6,149.5 feet. An offset to the north was successful; offsets to the east and south were failures.

Lincoln.—Successful completion of 1 of 15 wildcat wells marked the discovery of oil in the county. The new field, Red Willow Creek, was far removed from other fields; the nearest field was about 35 miles to the southwest. The Red Willow Creek discovery well (sec. 9, T. 9 N., R. 33 W.), completed late in November, initially pumped 85 barrels of oil per day. The producing zone was in the Cherokee formation between 4,498 and 4,501 feet. The hole bottomed at 4,533 feet, at which point it penetrated granite. No production was reported for the year.

The county's only mineral production was sand and gravel. Plants were operated by Gayman Sand & Gravel, Western Builders of North Platte, Inc., and Paxton Sand & Gravel Co. The sand and gravel was used mostly for building and paving.

Morrill.—The county ranked seventh in value of mineral production. About 95 percent of this production value came from oil.

Thirteen fields with 87 operating wells supplied the oil output. The Waitman field led in production of oil—280,000 barrels. The Graff, Lane, Lindberg, and Olsen fields each produced between 100,000 and 200,000 barrels. Two fields, Craig and Dunlap, each produced between 50,000 and 100,000 barrels. Output from the Waitman field was double over the 1960 total of 140,000 barrels; production in the Lindberg field increased 130,000 barrels and in the Graff field, 74,000 barrels. Output from the Olsen field decreased below the 109,000-barrel production of 1960. The Redington field, which produced less than 1,000 barrels of oil in 1960, reported no production for 1961. All 26 wildcat wells completed were dry holes.

The Bayard plant of The Great Western Sugar Co. produced lime for use in making beet sugar. Building and paving sand and gravel was produced by Dolson Gravel Co. and Lyman-Richey Sand & Gravel Corp. (Plant 23).

Nemaha.—The county ranked third in production of stone—about 5 percent more than in 1960. Colaska Production Co., Heebner Quarries, and Nelson Quarries, Inc., produced broken and crushed limestone which was used as riprap, road material, and for agricultural purposes.

Nuckolls.—Only cement and sand and gravel were produced; however, the county ranked sixth in value of mineral output. The Superior plant of Ideal Cement Co. manufactured portland and masonry cements; C. F. Bondegard, the only commercial sand and gravel operator, produced gravel for road construction. The Estate of George K. Werner produced some gravel under contract for use on highway maintenance.

Red Willow.—The oil activity in Red Willow County highlighted the mineral activity in the State. The sevenfold increase in petroleum production over that of 1960 was enough to change the county's ranking according to value of mineral production from seventh in 1960 to fourth, and according to oil production, from fifth to third.

The development of the Sleepy Hollow field, discovered in 1960, was outstanding. At the end of 1960, the field had only 19 operating wells, which had produced slightly over 100,000 barrels of oil. However, 1961 production came from 206 operating wells and was 3.7 million barrels of oil and made the Sleepy Hollow field the leading producer. It was the only field in the State that produced over 2 million barrels of oil, and supplied 15 percent of the State petroleum output. A 6-inch pipeline was laid to the Sleepy Hollow field to replace a 4-inch line previously available.

Petroleum production came from 9 fields with 294 operating wells. The Sleepy Hollow field, with 3.7 million barrels was the leading producer. The Ackman field ranked second with 535,000 barrels, an increase of about 80,000 barrels over that in 1960. The Silver Creek field, with 338,000 barrels, an increase of 333,000 barrels, ranked third. The other six active fields each produced less than 50,000 barrels of oil. The Bartley, Midway, Wolverine, and Zenith fields were the only new fields reporting production for the year—totaling 32,000 barrels.

One-fifth of all wildcat completions in the State were in Red Willow County, which dominated oil-exploratory activities. Six new fields were discovered by exploratory drilling. The producing zones of the new discoveries were relatively shallow (between 3,172 and 3,428 feet). The Bartley field discovery well (sec. 32, T. 3 N., R. 26 W.) pumped 25 barrels of oil per day; the producing zone was in the Lansing-Kansas City formation between 3,324 and 3,328 feet. Granite wash was reached at 3,430 feet. No offsets were drilled. Initial production of the Midway field discovery well (sec. 23, T. 1 N., R. 27 W.) of 110 barrels of oil per day on pump came from the Lansing-Kansas City formation between 3,214 and 3,226 feet. Precambrian rocks were encountered at 3,518 feet. Offsets to the northwest, west, and south were successful. The Wolverine field discovery well (sec. 25, T. 2 N., R. 27 W.) pumped 126 barrels of oil per day and cut 20 percent water from the Lansing-Kansas City formation between 3,363 and 3,372 feet. Granite was encountered at 3,667 feet. An offset to the east was a failure. Initial production from the Zenith field discovery well (sec. 12, T. 1 N., R. 28 W.) was 45 barrels of oil and 13 barrels of water per day on pump. The producing zone was from 3,313 to 3,325 feet in the Lansing-Kansas City formation. Granite was encountered at 3,622 feet. No offsets were drilled, but four exploratory wells drilled within a 1½-mile radius of the field were failures. The South Silver Creek field was one of two new fields which did not report production for 1961. The discovery well (sec. 31, T. 2 N., R. 26 W.) of this field pumped 96 barrels of oil per day and cut 1 percent water. The producing zone was in the Lansing-Kansas City formation from 3,270 to 3,400 feet. Drilling hit granite wash at 3,560 feet. The other new field that did not have production was the unnamed field in the Sleepy Hollow area. Initial production of the discovery well (sec. 21, T. 3 N., R. 27 W.) of this field, classed as marginal, was only 5 barrels of oil per day on pump. The producing zone was in the Lansing-Kansas City formation from 3,172 to 3,176 feet—the shallowest producing zone of any of the 1961 discoveries. Granite was encountered at 3,489 feet. No offsets were drilled.

Sand and gravel production, the county's other commodity, totaled 162,000 tons, 60,000 tons more than in 1960. The increase was due mainly to the Federal Bureau of Reclamation use of 70,000 tons of sand and gravel for dam fill, compared with 25,000 tons in 1960. Commercial sand and gravel operators were Davidson-Merritt Sand & Gravel Co., Gillen Sand & Gravel Co., McCook Sand and Gravel, and Midwest Sand & Gravel Co. Most of the output was used for building and paving. A small quantity was used for fill material and miscellaneous purposes.

Sarpy.—The county ranked eighth in value of mineral production. The output of sand and gravel was 8 percent more than in 1960, and stone production increased 2 percent. Lyman-Richey Sand & Gravel Corp. operated four sand and gravel plants (Nos. 2, 3 and 4, 7, and 8). Other commercial plant operators were Richfield Sand & Gravel Co. and Missouri Valley Redi-Mix Co. Most of the sand and gravel was used for building and paving.

Sand and gravel from Government-and-contractor operations was used for paving by the State department of roads. Stone Products, Inc., and Welsh Stone Co., Inc., crushed limestone for use in road building. A contractor produced limestone for use as riprap by the U.S. Army Corps of Engineers.

Scotts Bluff.—Petroleum production was only about one-half as much as that of 1960. The Cedar Canyon field production was only 59 percent of the 1960 output; the other active field, Roubadeau, produced only 44 percent of its 1960 production. The only completed wildcat well was a failure.

The Scottsbluff oil refinery of Cooperative Refinery Association was operated during the year. The plant used the gas-oil cracking thermal process and the platforming catalytic reforming process. Oilfields in southeastern Wyoming and Banner County were the principal sources of crude oil. Throughput for the year was 912,727 barrels of oil, 1 percent more than in 1960.

Only Harry F. Berggren & Sons, Inc., reported commercial sand and gravel production. The output was used for building. Trettenero Sand & Gravel Co. and K & F Sand & Gravel Co. supplied the Scotts Bluff County Highway Department with sand and gravel, which was used in paving.

The Mineral Industry of Nevada

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Nevada Bureau of Mines.

By L. E. Davis,[1] Roy Y. Ashizawa,[2] and L. Giorgetti[3]

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NEVADA'S total mineral production value in 1961 was virtually the same as in 1960, rising less than 1 percent. Greater output of nonmetallic minerals, particularly sand and gravel and magnesite, more than offset a decline in metal production. The 6 percent drop in value for the metal commodities reflected a lower average unit value, especially for copper and mercury.

Export trade was at a relatively high level for producers of magnesite and iron ore and concentrates. The tonnages of sand and gravel and stone were well above preliminary estimates, resulting from major increases in highway construction late in the year. There was a marked rise in crude petroleum production from Nevada's only field, although the total was small compared with production in other producing States.

Major developments in 1961 were completion of a $2 million expansion program by Basic, Inc., at its Gabbs magnesite-brucite mine and processing plant, Nye County; the first shipment of copper concentrate by The Anaconda Company from its new sulfide flotation mill at Weed Heights, Lyon County, in October; the letting of a contract by Standard Slag Co. for construction of an iron ore treatment plant near its Minnesota mine, Douglas County; exploration and development by Getchell Mine, Inc., at its gold property, Humboldt County, for planned open-pit mining and the milling of the ore in the company's altered tungsten mill; and new producing oil wells by Shell Oil Co. in the Eagle Springs field, Nye County.

Several significant developments adversely affected the mineral industries. Expiration of a Government purchase contract in July was instrumental in the shutdown of all mining and milling operations by Manganese, Inc., near Henderson, Clark County. The London Extension Mining Co., the last active straight lode-gold mine in Nevada, ended operations at its Goldacres property, Lander County, March 31 and disposed of all buildings and equipment. All mining and milling operations were closed by U.S. Milling and Minerals Corp., Esme-

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TABLE 1.—Mineral production in Nevada[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite short tons	[2] 86,061	[2] $591	129,524	$863
Copper (recoverable content of ores, etc.) do	77,485	49,745	78,022	46,813
Fluorspar do	18,505	388	18,129	357
Gem stones	(3)	100	(3)	100
Gold (recoverable content of ores, etc.) troy ounces	58,187	2,037	54,165	1,896
Gypsum thousand short tons	802	2,721	729	2,625
Iron ore (usable) thousand long tons, gross weight	[2] 740	[2] 3,683	845	4,608
Lead (recoverable content of ores, etc.) short tons	987	231	1,791	369
Manganese ore (35 percent or more Mn) short tons, gross weight [4] [5]	49,076	3,301	28,573	1,852
Mercury 76-pound flasks	7,821	1,648	7,486	1,480
Perlite short tons	35,214	286	29,544	240
Petroleum (crude) thousand 42-gallon barrels	27	(6)	[7] 152	(6)
Sand and gravel thousand short tons	4,085	5,224	7,095	7,443
Silver (recoverable content of ores, etc.) troy ounces	707,000	640	388,426	359
Stone thousand short tons	579	1,350	677	1,576
Talc and soapstone short tons	4,882	30	3,090	33
Zinc (recoverable content of ores, etc.) do	420	108	453	104
Values of items that cannot be disclosed: Clays, diatomite, lime, magnesite, manganiferous ores (1960), molybdenum concentrates (content), pumice (volcanic cinder), salt, sulfur ore, tungsten concentrate (60-percent WO_3 basis), uranium ore, and values indicated by footnote 6		[2] 8,809		10,811
Total Nevada [8]		[2] 80,335		80,565

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Revised figure.
[3] Weight not recorded.
[4] Includes concentrates and nodules.
[5] Quantity and value of low-grade shipments to custom mills not included.
[6] Figure withheld to avoid disclosing individual company confidential data.
[7] Preliminary figure.
[8] Total adjusted to eliminate duplicating value of limestone used in manufacturing lime.

ralda County, on August 1; and the Horse Canyon mercury mine of Gabbs Exploration Co., Nye County, ceased operating in September.

Employment and Injuries.—Statistics collected and compiled by the Federal Bureau of Mines in cooperation with the Nevada State Inspector of Mines disclosed an 8-percent overall increase in employment over that in 1960, while total man-hours worked rose 1.6 percent.

There were four fatal injuries in 1961, the same number as in 1960; however, all occurred at metal mines, whereas only one occurred at a metal mine in 1960. Nonfatal lost-time injuries were 18 percent higher than in 1960, and the injury frequency rate also was higher. By commodity groups, injuries did not follow the man-hour trend except at stone quarries, where a drop of 14 percent in man-hours worked was concurrent with 17 percent fewer nonfatal lost-time injuries. Three fatalities occurred at iron mines. One employee was crushed by rock while working underground, another was killed when struck by a train while working near the tracks, and a third was crushed between a conveyor system and a mechanical loader he was operating. The fourth fatality occurred at a tungsten operation where the driver of a truck was fatally injured by jumping when the vehicle went out of control.

Average weekly earnings, as reported by the Nevada Employment Security Department, rose from $114.54 in December 1960 to $122.26 in December 1961.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	1960[2]					
	Employees	Man-hours (thousands)	Injuries			Injury frequency rate[4]
			Fatal	Nonfatal	Total	
Metal mines and mills	2,768	6,043	1	76	77	12.74
Nonmetal mines and mills	734	1,583	1	37	38	24.01
Stone quarries	136	287	1	6	7	24.39
Sand and gravel operations	409	568	1	13	14	24.65
Total	4,047	8,481	4	132	136	16.04
	1961[3]					
	Employees	Man-hours (thousands)	Injuries			Injury frequency rate[4]
			Fatal	Nonfatal	Total	
Metal mines and mills	2,937	6,050	4	110	114	18.84
Nonmetal mines and mills	717	1,440	----------	35	35	24.31
Stone quarries	167	248	----------	5	5	20.16
Sand and gravel operations	544	876	----------	6	6	6.85
Total	4,365	8,614	4	156	160	18.57

[1] Excludes the mineral fuels industry and officeworkers. Data collected and compiled by the Federal Bureau of Mines in cooperation with the Nevada State Inspector of Mines.

[2] Final figures.

[3] Preliminary figures.

[4] Total number of disabling injuries during the year per million man-hours.

Consumption, Trade, and Markets.—More than one mineral commodity and both metallic and nonmetallic mineral production were reported from each county in Nevada except Storey, where mineral raw material output was limited to diatomite. Of the 27 different commodities produced in the State, 1 was classified as a mineral fuel (petroleum), 11 as metal ores or concentrates, and 15 as nonmetallic materials. Nevada industries consumed all clays, volcanic cinder, salt, sand and gravel, and stone (except limestone) produced in the State, and part of the crude perlite, crude gypsum, limestone, and tungsten concentrate. Much of the crude limestone and gypsum not consumed within the State was processed for out-of-State customers. Most metal ores were concentrated or further processed before shipment. The ores, concentrates, and residues largely were consigned to mills and smelters in neighboring States or sold directly to consumers, inasmuch as Nevada had only one smelter (copper) and no refineries. Iron ore and concentrate, magnesite and magnesia products, crude perlite, and processed diatomite were exported by Nevada producers. At Henderson, Clark County, titanium minerals imported from Australia were processed to the metal and its alloys, manganese ores imported from Mexico were treated to obtain electrolytic manganese dioxide, and salt from California was utilized to produce chlorine gas and caustic soda.

Legislation and Government Programs.—Several sections of the Nevada State Mining Laws were revised by the Nevada Legislature. The revised sections, and the dates in 1961 that became effective were as fol-

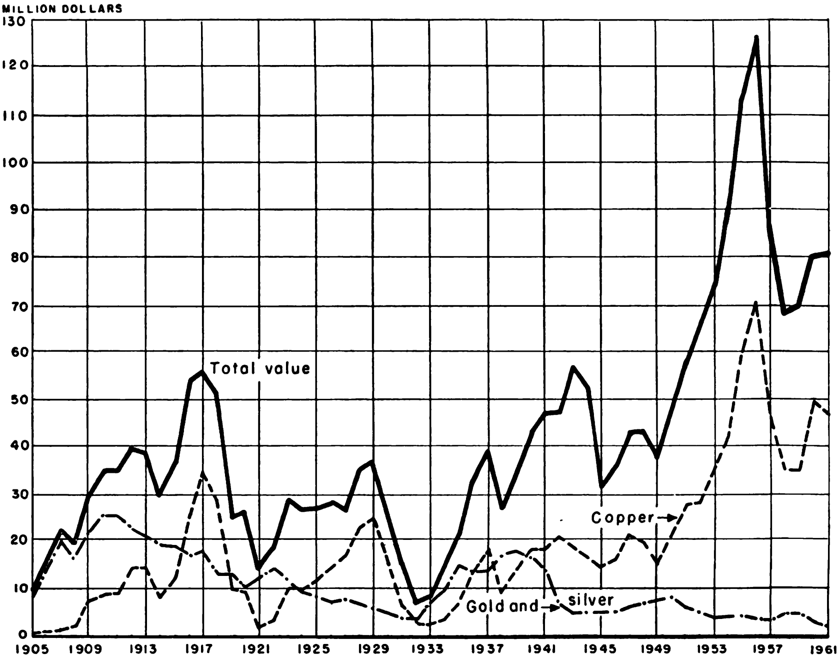

FIGURE 1.—Value of gold and silver, copper, and total value of mineral production in Nevada, 1905–61.

lows: Section 517.040, on location work for the lode mining claims and section 517.050, on location certificates for lode claims, March 13; section 517.230, on proof of labor and section 517.280, on location certificates, April 15; and section 108.200, on actions and liens, July 1.

Eight Public Land Orders during 1961 restored to operation of the public land laws 152,390 acres that had been withdrawn for various uses by Federal agencies. Included were over 109,000 acres in Clark County that had been earmarked for reclamation purposes and about 43,000 acres in Mineral County that were in use by the U.S. Navy. In addition, effective February 8 about 103,900 acres in Pershing, Humboldt, Eureka, Lincoln, White Pine, Elko, and Washoe Counties was conveyed to the United States. However, only the acreage in the last three named counties was open to location under the United States Mining Laws.

Only one exploration and development contract under the supervision of the Office of Minerals Exploration was still in effect at the beginning of 1961. The contract was with Gold Eagle Mines, Inc., at lead-zinc claims in Esmeralda County. Recessed during the winter of 1960–61, the contracted operations were completed in December 1961. No new contracts were executed during 1961, leaving no OME contracts in effect at yearend.

A Government contract to purchase manganese nodules from Manganese, Inc., begun in 1952, was completed in August 1961.

At the Federal Bureau of Mines Reno Metallurgy Research Center, emphasis was placed on the electrowinning of rare and ferrous metals and the electrodeposition of certain binary alloys. Studies in electrorefining of various metals were in progress at the Bureau of Mines Boulder City Research Laboratory, including a cooperative research project for high-purity metals with the University of California Lawrence Radiation Laboratory and the Atomic Energy Commission.

The Bureau's mining research stressed geologic structure versus configuration of rock slopes, in situ determination of physical properties of open-pit slope materials, theoretical stress fields in open-pit slopes, and rock stress-relief measurements. One phase of the fieldwork on the latter activity was completed in December under a cooperative agreement with a mining company in White Pine County.

Bureau of Mines resources work included the collection and dissemination of statistics on minerals and accidents in Nevada in cooperation wth State agencies. Work was continued on the domestic mercury resources potential, including Nevada beryllium resources investigations and mineral raw materials used in the chemical industries. Under a cooperative agreement with the Nevada Bureau of Mines, the clay resources of Nevada were under investigation.

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—The Nokai Dome Oil Co. antimony property in the *Taylor* mining district, White Pine County, was inactive during 1961. At the Pacific claim in the *Black Knob* mining district, Pershing County, only assessment work was done. The White Caps mine near Manhattan, Nye County, was being explored.

Beryllium.—Underground exploration of the beryllium-bearing fissures and quartz veins of the Mount Wheeler and Jeppson properties southeast of Ely, White Pine County, was completed by a contractor for The Anaconda Company, and beryllium-bearing quartz veins in the Fish Creek area, Eureka County, were explored by Union Carbide Nuclear Corp. The Virgin Mountains beryllium deposits south of Mesquite, Clark County, and the Lynch Creek beryllium-tungsten prospect south of Austin, Lander County, were investigated by Bureau of Mines engineers. Both properties were sampled after bulldozer stripping and trenching. Beryllium Associates of Salt Lake City, Utah, which had leased claims in the Virgin Mountains area earlier, continued exploration begun in 1960.

Copper.—Although there was a slight increase in the production of recoverable copper, the total value declined nearly 6 percent because the unit price averaged 2 cents a pound less than in 1960. Virtually all the copper recovered from ores mined in Nevada came from the mines of Kennecott Copper Corp., White Pine County; The Anaconda Company, Lyon County; and Bristol Silver Mines, Lincoln County; and from properties in the Copper Canyon and Copper Basin areas, Lander County. Of the 22 active mines contributing to the copper output, only 9 were classified as copper mines. Kennecott Copper Corp. limited its mining activities to the Liberty pit, where the tonnage of waste removed was about 3 times that of ore mined. The company made stockpile withdrawals of ore previously mined from the Tripp and Veteran pits. Several thousand feet of exploratory drilling was done in the Liberty pit area during the year. Anaconda mined both sulfide and oxide copper ores at its Yerington mine and began treating sulfide ores in its new flotation plant in October. The company shipped copper concentrates and precipitates from the oxide leaching plant to its Montana smelting facilities. The waste-to-ore ratio of all material mined in the pit area was approximately 1.3 to 1. Bristol Silver Mines Co. completed about 3,000 feet of long-hole drilling and more than 800 feet of drifts and raises in exploration and development during the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing[2]		Material sold or treated[3] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
1952-56 (average)	125	10	9,649	87,804	$3,073	807,515	$731
1957	107	9	11,770	76,752	2,686	958,477	868
1958	102	14	9,792	105,087	3,678	932,728	844
1959	67	10	8,788	113,443	3,971	611,135	553
1960	72	9	12,013	58,187	2,037	707,291	640
1961	62	10	12,067	54,165	1,896	388,426	359
1904-61 [4]			(5)	15,167,258	378,874	316,313,190	217,263

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	69,871	$46,471	4,775	$1,430	6,472	$1,874	$53,579
1957	77,750	46,806	5,979	1,710	5,292	1,228	53,298
1958	66,137	34,788	4,150	971	91	19	40,300
1959	57,375	35,228	1,357	312	217	50	40,114
1960	77,485	49,745	987	231	420	108	52,761
1961	78,022	46,813	1,791	369	453	104	49,541
1904-61 [4]	2,728,810	1,055,458	391,650	62,288	483,073	93,423	1,807,306

[1] Includes recoverable metal content of gravel, washed (placer operations); ore milled; old tailings or slimes retreated; and ore, old tailings, and slag shipped to smelter during calendar year indicated.

[2] Excludes itinerant prospectors, "snipers," "high graders," and others who gave no evidence of legal right to property.

[3] Does not include gravel washed.

[4] From 1904, when first satisfactory annual canvass of mine production was made, to 1961, inclusive.

[5] Data not available.

TABLE 4.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Clark	7	----------	134	$4,690	2,358	$2,180
Douglas	2	----------	2	70	247	228
Elko	5	----------	79	2,765	11,802	10,911
Esmeralda	7	----------	2,310	80,850	65,305	60,374
Humboldt	1	2	164	5,740	31	28
Lander	5	1	(2)	(2)	1,015	939
Lincoln	4	----------	106	3,710	(2)	(2)
Lyon	2	----------	1	35	----------	----------
Mineral	3	----------	797	27,895	18,430	17,038
Nye	5	5	845	29,575	1,403	1,297
Pershing	3	2	82	2,870	46	43
Undistributed [3]	18	----------	49,645	1,737,575	287,789	266,058
Total	62	10	54,165	1,895,775	388,426	359,096

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Clark	22,600	$6,780	2,156,700	$222,140	109,400	$12,581	$248,371
Douglas	----------	----------	----------	----------	----------	----------	298
Elko	1,400	420	171,400	17,654	29,900	3,438	35,188
Esmeralda	(2)	(2)	(2)	(2)	(2)	(2)	141,224
Humboldt	----------	----------	----------	----------	----------	----------	5,768
Lander	207,800	62,340	6,000	618	1,300	149	64,046
Lincoln	(2)	(2)	(2)	(2)	(2)	(2)	3,710
Lyon	(2)	(2)	----------	----------	----------	----------	35
Mineral	100	30	269,500	27,759	6,500	748	73,470
Nye	(2)	(2)	(2)	(2)	(2)	(2)	30,872
Pershing	----------	----------	----------	----------	----------	----------	2,913
Undistributed [3]	155,812,100	46,743,630	978,400	100,775	758,900	87,274	48,935,312
Total	156,044,000	46,813,200	3,582,000	368,946	906,000	104,190	49,541,207

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Includes Churchill, Eureka, Washoe, White Pine Counties, and counties indicated by footnote 2.

Gold.—Total gold output declined about 7 percent from the 1960 figure. The decline was attributed primarily to closing of the Goldacres open-pit mine, Lander County. Nearly 98 percent of the total recoverable gold in 1961 was credited to lode mines; 83 percent was recovered as a byproduct in the treatment of copper ores. Silver ores mined in Esmeralda County and lead ores from mines in Eureka and Mineral Counties contributed much of the remaining lode gold. The 10 placer properties that were active in Nevada during 1961 added less than 1,100 ounces to the total.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Gold	26	36,239	5,624	2,853	----------	----------	200
Silver	16	11,598	1,801	99,122	8,500	76,300	80,000
Copper	9	12,008,578	44,011	241,222	156,007,800	415,500	415,200
Lead	6	3,778	1,440	42,854	12,700	902,500	149,800
Lead-zinc	3	376	----------	1,226	600	31,900	75,800
Zinc	2	283	1	31	----------	21,100	139,000
Total	62	12,060,852	52,877	387,308	156,029,600	1,447,300	860,000
Other "lode" material:							
Gold (slag)	(2)	5	175	85	----------	200	400
Lead residue	(2)	5,523	----------	497	14,400	2,134,500	45,600
Old tailings	(2)	700	18	12	----------	----------	----------
Total	(2)	6,228	193	594	14,400	2,134,700	46,000
Total "lode" material	62	12,067,080	53,070	387,902	156,044,000	3,582,000	906,000
Gravel (placer operations)	10	(3)	1,095	524	----------	----------	----------
Total all sources	72	----------	54,165	388,426	156,044,000	3,582,000	906,000

[1] Details will not necessarily add to totals because some mines produce more than 1 class of material.
[2] From property not classed as a mine.
[3] 15,690 cubic yards.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in 1961, by types of material processed, and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation and cyanidation: Ore	7,097	65,873	----------	----------	----------
Concentration and smelting of contrates: Ore	43,072	176,590	154,304,300	9,500	2,000
Direct smelting:					
Ore	2,726	144,857	1,725,300	1,437,800	858,000
Slag	175	85	----------	200	400
Lead residue	----------	497	14,400	2,134,500	45,600
Total	2,901	145,439	1,739,700	3,572,500	904,000
Placer	1,095	524	----------	----------	----------
Grand total	54,165	388,426	156,044,000	3,582,000	906,000

Iron Ore.—Shipments of usable iron ore were 14 percent greater than in 1960; however, the increase was credited to the output of direct-shipping ores. Production and shipments of iron concentrates were one-third lower than in 1960. Virtually all the iron concentrates and a high percentage of the direct-shipping ore were shipped to the port of Stockton, Calif., for transshipment to Japanese pig iron and steel plants. Exploration for iron ore was at a high level in 1961. The following companies were active: W. S. Moore & Son, Southern Pacific Co., and United States Steel Corp. in Pershing and Churchill Counties; Utah Construction and Mining Co. in Lyon and Eureka Counties;

Pacific States Steel Co. in Humboldt and Mineral Countries; and A R D Equipment Co., Inc., in Lander County. Of the 16 active iron properties in 9 counties, the Iron King in Humboldt County was the only underground operation. Only one concentrator was operated during the year—by Standard Slag Co. at the Minnesota mine in Douglas County. Late in 1961 Standard Slag contracted for the construction of a 500,000-ton-a-year capacity treatment plant to be located near the mine. The plant was to incorporate crushing, magnetic separation, and sintering units. Shipments of iron ore sinter from the plant were scheduled for April 1962.

Iron ore shipments were made from properties in 1961 that were unreported in 1960 except for exploration and development. These were the McCoy mine near the old Hancock iron property, Lander County; the Madallena prospect near Simon, Mineral County; the Gabbs (Eddy) property in the Sherman Peak area, Nye County; and the Seaforth deposit at the south end of Brunswick Canyon in Ormsby County near the Douglas County line.

Iron and Steel Scrap.—Ferrous scrap consumption, including consumption of shredded detinned cans at The Anaconda Company copper-leaching plant, Lyon County, was slightly lower than in 1960, owing to the plant's reduced rate of production after the company's sulfide concentrator started up late in 1961. Home scrap produced was down more than 50 percent, while purchased scrap received was somewhat higher.

Lead.—Recoverable lead production was more than 80 percent higher than in 1960. Nearly 60 percent of the lead was recovered as lead residue in treating manganese ores in Clark County; 25 percent, from lead ores mined in Elko, Eureka, Mineral, and White Pine Counties; 11 percent, from copper ore produced in Lincoln County; and 4 percent, from all other primary sources. While 21 mines contributed to the total lead output, the major producers were Three Kids mine (manganese ore), Clark County; Bristol Silver mine (copper ore), Lincoln County; New Potosi mine (lead ore), Mineral County; and Hamilton mine (lead ore), White Pine County.

Manganese.—The State's entire output of manganese ore and concentrates during 1961 was obtained from the Clark County properties of Manganese, Inc. The ore was concentrated and nodulized for shipment to the General Services Administration (GSA). The GSA contract expired in 1961, and the company ceased mining and milling operations in July. Before yearend all machinery, equipment, and buildings were readied for sale by auction, advertised to take place in January 1962. Company-owned real estate and mining claims were not included. Three other manganese properties, the Black Devil mine, Lander County, and the Sunshine claims and Manganese mine, White Pine County, were idle throughout the year except for assessment and maintenance work. At Henderson, Clark County, American Potash & Chemical Corp. produced electrolytic manganese dioxide from foreign ore.

Mercury.—The tonnage of mercury ores mined and treated was about 43 percent higher than in 1960, but 4 percent less metal was recovered. Although the grade of furnaced ores was only slightly lower, mercury in retorted ores averaged 2.4 pounds per ton less than in 1960. Shipments rose 22 percent, and yearend stock dropped 47 percent. The output came from properties in five counties. Humboldt County deposits yielded 90 percent of production and shipments. The Cordero mine near McDermitt, Humboldt County, was the State's major producer and the second largest in the United States. Only four mines, one each in Esmeralda, Humboldt, Nye, and Pershing Counties, individually yielded more than 100 flasks in 1961.

TABLE 7.—Mercury production by methods of recovery

Year	Direct-furnaced		Retorted		Unclassified,[1] flasks	Total		Operating mines
	Ore (short tons)	Flasks	Ore (short tons)	Flasks		Flasks	Value [2]	
1952–56 (average)	31,092	4,441	1,626	228	3	4,672	$1,167,402	25
1957	118,216	17,632	31,605	3,132	41	6,313	1,559,185	45
1958						7,336	1,680,384	35
1959						7,156	1,627,847	20
1960	98,277	14,132	30,904	1,175	----------	7,821	1,648,354	20
1961						7,486	1,479,308	21

[1] Includes mercury recovered from miscellaneous dump material.
[2] Value calculated at average New York price.

Molybdenum.—Molybdenite concentrate was produced by Kennecott Copper Corp. at its McGill concentrator, White Pine County. The mineral was recovered as a byproduct in treating copper ores from the nearby *Robinson* mining district. Production and shipments were slightly above 1960 figures. There was considerable exploration for molybdenum in Nevada during the year. The Anaconda Company drilled the Owyhee prospect southwest of Mountain City, Elko County, and continued its extensive diamond-drilling program at the Hall property north of Tonopah, Nye County. In Esmeralda County, Bear Creek Mining Co. relinquished its option on the Cucamonga deposit after completing an extensive drilling program.

Silver.—Recoverable silver production declined 45 percent from the 1960 figure, owing principally to the closing of mining and milling operations at Silver Peak, Esmeralda County, by U.S. Milling and Minerals Co. Only 25 percent of the lode silver output was derived from silver ores; 62 percent was recovered as a byproduct from the treatment of copper ores, 11 percent from lead ores, and less than 2 percent from all other lode sources. More than 90 percent of the lode silver output was recovered from the ores of seven mines: The Liberty open-pit copper mine and the Ward group (Mammoth) mine, White Pine County; the Mohawk, Ohio, and Weepah silver mines, Esmeralda County; the Bristol silver-copper mine, Lincoln County; and the New Potosi lead mine, Mineral County. Argentum Mining Co., a former silver producer in Mineral County, was idle throughout 1961. Ten active placer properties, in four counties, yielded a combined total of only 524 ounces of silver.

Tungsten.—Tungsten ore was mined and treated at seven properties during 1961, three in Churchill County, two in Pershing County, and one each in Mineral and Nye Counties. Production of tungsten concentrates was more than twice that in 1960, and shipments were nearly

14 times the 1960 figure, owing principally to stocks shipped by Getchell Mine, Inc., to Union Carbide Nuclear Co. in California. All other shipments of tungsten concentrates in 1961 were consigned to the tungsten carbide operation of Nevada Scheelite Division, Kennametal, Inc., near Rawhide, Mineral County. A high percentage of 1961 tungsten concentrate production was from ore and dump material treated at the Hilltop group, Churchill County. Stocks of tungsten concentrates, chiefly from ores mined in previous years, held at mines and plants in Nevada were reduced about 40 percent by yearend.

Uranium.—Production and shipments of uranium ore declined 90 percent from the 1960 figure. Commercial ore was produced from a deposit in Elko County near Mountain City and shipped to a Salt Lake City processing plant. About 50 tons of uranium ore was mined near the Strosnider ranch, Lyon County, and shipped to the same processor, but there was no report as to whether the ore was of commercial grade.

Zinc.—A rise of nearly 8 percent in output of recoverable zinc during the year was due in a large part to increased production at the Argentena lead-zinc mine, Clark County, and a higher zinc recovery from copper ores mined at the Bristol silver mine, Lincoln County. Of the total zinc output, 46 percent was recovered from copper ores, 17 percent from lead ores, 15 percent from zinc ores, 9 percent from silver ores, 8 percent from lead-zinc ores, and 5 percent from manganese ores (lead residue). The major producers were Bristol Silver Mines Co. (copper ore), Lincoln County; MIA Mines Co. (zinc ore), Eureka County; Durham Peanut Co. (silver ore), White Pine County; Hamilton Corp. (lead ore), White Pine County; and Complex Metals Corp. (lead-zinc ore) and Manganese, Inc. (manganese ore), Clark County.

Other Metals.—Two cobalt-nickel prospects in Lander County were idle in 1961 except for assessment and maintenance work. The Glasco columbium-tantalum claims near Denio, Humboldt County, were idle throughout the year, and no activity of any kind was reported from the Rainbow group of claims (titanium minerals), Nye County, or the Myrtle rutile prospect, Washoe County. Titanium Metals Corp. of America, Henderson, was experimenting with ilmenite as a source of titanium metal. The company was using rutile imported from Australia as a raw material. A tin prospect near Rabbit Hole, Pershing County, was inactive during 1961. Exploration by rotary drilling, begun in 1960, was continued at the Siskon vanadium property in the *Fish Creek* mining district, Nye County.

NONMETALS

Barite.—Mine output of crude barite was 45 percent less than in 1960; however, shipments by producers rose 51 percent, and stockpiles of the crude mineral were reduced 47 percent at yearend. Most of the shipments, 68 percent, were from two mines, one each in Elko and Lander Counties. Nine other barite properties, one each in Elko and Humboldt Counties, three in Lander County, and four in Mineral County, contributed the remainder. The Humboldt County property, the Little Britches mine near Golconda, was a new producer in 1961.

The State's only grinding plant, the Magnet Cove mill at Battle Mountain, crushed and ground crude barite from the company mine in Lander County. The plant product was utilized as a component in compounding well-drilling mud at company facilities in Texas. California grinders received virtually all the other crude ore shipments.

Brucite and Magnesite.—Basic, Inc., and Standard Slag Co. mined magnesite from deposits in the Gabbs area, Nye County, and treated the mineral in nearby plants, producing caustic-calcined and refractory magnesias and various refractory products. Basic, Inc., mined no brucite in 1961, but made shipments from beneficiated stockpiled ore. Production of magnesite rose 47 percent; the tonnage of brucite shipped was more than seven times the 1960 figure. During the year Basic, Inc., completed an expansion program at its mine and processing plant. As a result, processed magnesia clinker no longer had to be shipped to the company's Ohio plant for conversion to special refractories.

Clays.—Production of clays was entirely from captive operations. The quantity of fire clay and miscellaneous clay consumed by producers in the manufacture of furnace mortar, refractory and fire brick, and heavy clay products was down 31 percent, while fuller's earth and bentonite consumption at producers' plants outside the State rose 16 and 6 percent, respectively. Fuller's earth was mined from one pit in Lyon County, bentonite from one underground mine in Nye County, and fire clay and miscellaneous clay from three open-pit operations in Washoe County.

Diatomite.—Output of crude and prepared diatomite was 7 percent greater than in 1960, owing chiefly to increased sales of filter-grade material. The ore came from five open-pit operations, one each in Churchill, Esmeralda, Lincoln, Pershing, and Storey Counties. All producers except one processed diatomite in company-owned preparations plants at or near the pit sites. A plant in Lyon County processed crude material from the producer's Churchill County pit. About 33 percent of the prepared material was sold for use as a filler; nearly 21 percent, for filtration; and moderate tonnages, for insulation, abrasives, poultry litter, and various other uses. Major consumers were paint, paper, insecticide, and chemical manufacturers in the United States, Canada, Europe, South Africa, and South America. A small tonnage of the crude mineral was sold for use as a stock-feed supplement.

Fluorspar.—Crude fluorspar production rose 16 percent above the 1960 figure, but the tonnage shipped to consumers was essentially unchanged. Metallurgical-grade fluorspar obtained from the Crowell mine, Nye County, and the Carp mine, Lincoln County, was consigned to west coast steel mills. The Goldspar mine, Nye County, yielded crude fluorspar utilized in the producer's California cement plant.

Gem Stones.—Individual collectors, mineralogical societies, and commercial producers reported the collection of a variety of gem materials. Petrified wood, the principal gem material collected, was found near Midas, Elko County; in the Paradise Valley and Badger Creek areas, Humboldt County; and in the Gabbs Valley area, Mineral County. Locations in Humboldt County yielded appreciable quantities of rhodonite. Significant quantities of other gem materials reported by collectors included fluorspar gathered in the *Iowa Canyon* mining district, Lander County; jade in Fish Lake Valley, Esmeralda County; opal at various sites in Humboldt, Lander, and Lyon Counties; turquoise in Lander and Mineral Counties; wonderstone near Fallon, Churchill County; agate in Clark, Lyon, and Mineral Counties; and quartz crystal in Churchill, Mineral, and Washoe Counties. Obsidian, copper specimens, agatized and opalized wood, orpiment, and jasper were also collected.

Gypsum.—The building material industry's lower demand for gypsum products was reflected in the crude gypsum production, about 73,000 tons less than in 1960. A substantial part of the output was shipped to California as crude mineral and in finished gypsum products. The quantity of uncalcined gypsum sold for use as cement retarder was well below the 1960 figure. Sales of agricultural gypsum, nearly 70 percent of which was sold to Nevada consumers, were 22 percent higher than in 1960. Crude gypsum was mined near Blue Diamond and Apex, Clark County, and Empire, Washoe County. Calcining plants were operated at Blue Diamond and Empire. Crude gypsum from the Apex mine was upgraded and shipped to a California calcining plant. A gypsum deposit near the Utah line east of Carp, Lincoln County, was explored by Wells Cargo, Inc., but no mineral was mined or shipped.

Lime.—Output of quicklime and hydrated lime at plants in Clark and White Pine Counties was slightly below 1960 figures. The decline was due to a lower demand for construction lime and a drop in consumption at the copper concentrator of Kennecott Copper Corp. at McGill. The company suspended its limekiln operation December 15 and began purchasing lime from U.S. Lime Products Division, The Flintkote Co., Clark County. The latter company produced quicklime at its Apex plant, quicklime and hydrated lime at Henderson, and hydrated lime at Sloan, principally for shipment to out-of-State customers. Construction of the Argentum Mining Co. Esmeralda County lime plant, which was begun in 1960, was suspended during 1961.

Perlite.—Continuing a trend begun in 1959, production of crude perlite declined because of reduced sales to out-of-State customers. Three active deposits, two in Lincoln County and one in Pershing County, yielded Nevada's total output. The crude mineral was expanded at plants in Clark and Washoe Counties for use as a lightweight aggregate in plaster and concrete and in the manufacture of plasterboard.

Pumice (Volcanic Cinder).—Three active deposits, one each in Mineral, Nye, and Ormsby Counties, yielded the entire output of volcanic cinder. The tonnages of crude and prepared cinder sold or used increased appreciably, compared with the 1960 figures. The crude material was crushed, ground, and screened for use as lightweight aggregate, principally in the manufacture of concrete building block.

Salt.—Solar salt was surface-mined from a dry lake near Sand Springs, southeast of Fallon, Churchill County, by a contractor for Leslie Salt Co. The entire output of the crude mineral was consumed locally. A dry-lake saline deposit in Clayton Valley near Silver Peak, Esmeralda County, was under exploration by drilling during the year, and a California chemical company drilled several salt wells in the Overton Beach area, Clark County, in an attempt to delineate a salt deposit and develop a local source for the mineral.

Sand and Gravel.—Rights-of-way acquisitions and the letting of sizable Federal-aid contracts for the Interstate Highway System accelerated Nevada's road construction program. As a result, production of sand and gravel rose from the subnormal 1960 total of 4 million tons to more than 7 million tons. However, the average unit value dropped to $1.05 a ton, owing to the relatively large volume of pit-run gravel used for road base. Nevada State Highway Department requirements for construction and maintenance totaled 4.4 million tons of processed and pit-run sand and gravel, 2.9 million tons more than in 1960. Although much of the increased output was by contractors and crews for the State agency, commercial producers with fixed plants also reported greater quantities of sand and gravel used in paving in 1961.

Churchill, Clark, Humboldt, and Washoe Counties each had deposits yielding over 1 million tons of sand and gravel for all uses.

TABLE 8.—Sand and gravel sold or used by producers, by classes of operations and uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Glass	(1)	(1)	(1)	(1)
Molding	(1)	(1)	(1)	(1)
Building	312,356	$501,353	364,267	$611,489
Paving	102,537	112,448	151,404	169,832
Fill	23,457	21,170	20,661	20,494
Other	(1)	(1)	49,547	114,153
Gravel:				
Building	502,057	762,109	472,797	785,552
Paving	791,970	767,590	1,180,536	838,198
Railroad ballast	5,186	5,705	(1)	(1)
Fill	(1)	(1)	255,933	258,894
Other	(1)	(1)	(1)	(1)
Undistributed sand and gravel	297,098	711,037	140,279	557,046
Total sand and gravel	2,034,661	2,881,412	2,635,424	3,355,658
Government-and-contractor operations:[2]				
Sand:				
Building	6,076	8,525	1,257	4,525
Paving	256,247	339,482	76,839	69,542
Fill	65	65	8,550	14,250
Total	262,388	48,072	86,646	88,317
Gravel:				
Building	8,881	12,143	1,809	6,512
Paving	1,763,185	1,974,464	4,350,947	3,971,010
Fill	15,869	7,747	114	57
Other	----------	----------	20,070	21,642
Total	1,787,935	1,994,354	4,372,940	3,999,221
Total sand and gravel	2,050,323	2,342,426	4,459,586	4,087,538
All operations:				
Sand	861,930	1,558,174	803,827	1,549,696
Gravel	3,223,054	3,665,664	6,291,183	5,893,500
Grand total	4,084,984	5,223,838	7,095,010	7,443,196

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.
[2] Includes figures for State, counties, municipalities, and other Government agencies.

The output of high-purity industrial silica sands in the Overton area, Clark County, was nearly 15 percent greater than in 1960. A new silica sand deposit was opened in Lincoln County near Panaco, and a grinding plant was constructed. Some of the plant product was utilized in the Glen Canyon Dam near Page, Ariz.

Stone.—Greater quantities of granite, limestone, and miscellaneous stone were quarried in 1961, increasing the total stone output to 677,000 tons, nearly 100,000 tons more than in 1960. Miscellaneous stone was quarried in nearly all counties for highway use as riprap and in Lincoln County for railroad ballast. Clark County quarries were the principal sources of limestone used for lime, metallurgical flux, chemicals, and various other industrial uses. The limestone quarry of Kennecott Copper Corp. was closed near yearend and was not expected to be reactivated in the near future. Much of the granite obtained from a Clark County quarry was utilized for riprap in an irrigation project. Washoe County deposits were the source of decomposed granite used as road base and of calcareous marl produced for use in poultry and livestock feeds and for agricultural purposes. Dimension building stone was produced at basalt, sandstone, quartz, and quartzite quarries in Clark, Humboldt, Lander, and White Pine Counties. High-grade silica (opalite) was quarried and ground in Esmeralda County, marble from Mineral County was used for terrazzo, and a small tonnage of marble from Clark County was prepared for roofing granules.

TABLE 9.—Stone sold or used by producers, by uses[1]

Use	1960		1961	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough architectural................cubic feet..	[2] 27,525	[2,3] $111,711	[4] 12,307	[4,5] $66,600
Approximate equivalent.......short tons..	[2,3] 4,862	------------	[4,5] 2,946	------------
Sawed stone and cut block..............cubic feet..	(6)	(6)	(6)	(6)
Approximate equivalent.......short tons..	(6)	------------	(6)	------------
Total,[7] approximate...............do....	4,862	111,711	2,946	66,600
Crushed and broken stone.......................do....	574,061	1,238,771	674,419	1,509,494
Grand total,[7] approximate.........do....	578,923	1,350,482	677,365	1,576,094

[1] Includes basalt, granite, marble, calcareous marl, sandstone, and miscellaneous stone.
[2] Includes sawed stone and cut block and flagging.
[3] Includes rubble, rough construction stone, sawed stone, and cut block and flagging.
[4] Includes sawed stone and cut block.
[5] Includes rubble, rough construction, sawed stone, and cut block.
[6] Figure withheld to avoid disclosing individual company confidential data.
[7] Total for 1960 includes rubble and rough construction dimension stone and flagging.

Sulfur Ore.—Production of sulfur ore from Nevada's only active sulfur deposit, near Sulphur, Humboldt County, dropped 44 percent below the 1960 output. Shipments, principally for use as a soil aid, totaled less than half those of the previous year. Sulfur ore consumed in the acid plant of The Anaconda Company at Weed Heights, Lyon County, was obtained from a California source.

Talc and Soapstone.—Production of talc and soapstone declined to the lowest level since 1940, and was 37 percent below the 1960 figure. However, the value of shipments to grinders rose 12 percent because most of the output was talc. Production came entirely from deposits in Esmeralda County.

Water.—Magma Power Co. and associated companies continued investigations of sources for geothermal power. During the year three wells were completed at Geyser Terrace near Beowawe, Eureka County; three new wells were drilled at Brady's Hot Springs, Churchill County; and two exploratory wells were put down in the Steamboat Springs area, Washoe County. The company estimated that the three wells in the Geyser Terrace area were capable of developing 40,000 kilowatts of electricity, using a double-flash cycle of power generation.

MINERAL FUELS

Petroleum.—The Eagle Springs field in Nye County continued to be the State's entire source of crude petroleum. Production in 1961 was more than five times the 1960 yield, with an output of 152,000 barrels. The increase was attributed largely to one well, completed in February. At yearend the field consisted of four wells, two producing and two shut-in. Shell Oil Co. was the only producer; however, there was sporadic activity by other companies. A well was drilled in White Pine County, north of the Eagle Springs field and a few miles southwest of Mount Hamilton, but was abandoned when structural complexities were discovered in the 2,000- to 3,000-foot interval.

A products pipeline from Colton, Calif., to Las Vegas was completed in 1961. The line was designed primarily to deliver jet fuel to Nellis Air Force Base near Las Vegas.

REVIEW BY COUNTIES

Churchill.—Two producers near Fallon supplied sand and gravel for building and paving and for constructing a five-story concrete building to house radio and radar facilities at the nearby Naval Auxiliary Air Station. Substantial quantities of sand and gravel were used in a paving project on the Fallon Indian Rservation under a Federal Bureau of Indian Affairs contract. Pit-run and prepared sand and gravel were produced for the Nevada Highway Department by Dodge Construction Co. and used in road construction near Frenchman's Station, and by Wells Cargo, Inc., for building 14.8 miles of Interstate Route 80, near the Pershing County line. Highway maintenance crews produced and used nearly 5,600 tons of sand and gravel in the county. Crews and contractors for the Nevada Highway Department also quarried and prepared miscellaneous stone used in construction and maintenance of roads. E. J. Huckaby Trucking Co. surface-mined salt from a dry lakebed near Sand Springs east of Fallon. The crude mineral was consumed locally. An open-pit deposit near the county road between Nightingale and U.S. Highway 40 yielded crude diatomite subsequently processed in the producer's Fernley plant, Lyon County.

TABLE 10.—Value of mineral production in Nevada, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Churchill	$389,063	$1,476,205	Sand and gravel, tungsten, stone, salt, iron ore, gold, silver, gem stones.
Clark	11,718,209	10,577,352	Lime, sand and gravel, manganese nodules, gypsum, stone, lead, zinc, copper, gold, silver.
Douglas	1,549,103	1,483,315	Iron ore, sand and gravel, silver, stone, gold.
Elko	647,241	753,034	Sand and gravel, barite, lead, silver, uranium, zinc, gold, mercury, gem stones, copper, stone.
Esmeralda	969,741	662,113	Diatomite, gold, silver, mercury, talc and soapstone, sand and gravel, zinc, gem stones, lead, copper.
Eureka	238,123	1,199,186	Iron ore, sand and gravel, gold, zinc, lead, silver, stone, copper.
Humboldt	2,698,072	3,554,729	Mercury, sand and gravel, iron ore, tungsten, stone, barite, gold, gem stones, sulfur ore, silver.
Lander	970,364	1,048,159	Barite, iron ore, sand and gravel, copper, gem stones, silver, lead, zinc, stone.
Lincoln	1,386,807	725,786	Perlite, sand and gravel, copper, stone, silver, fluorspar, zinc, lead, gold, diatomite.
Lyon	20,232,382	18,956,841	Copper, diatomite, sand and gravel, stone, clays, gem stones, gold.
Mineral	[1] 233,591	236,835	Iron ore, barite, gold, lead, silver, stone, gem stones, zinc, tungsten, pumice (volcanic cinder), copper.
Nye	[1] 1,710,673	3,171,872	Magnesite, fluorspar, petroleum, sand and gravel, mercury, gold, iron ore, pumice (volcanic cinder), tungsten, silver, clays, copper, lead, zinc.
Ormsby	(²)	60,883	Pumice (volcanic cinder), iron ore, sand and gravel.
Pershing	2,917,884	3,561,270	Diatomite, iron ore, gypsum, sand and gravel, mercury, perlite, tungsten, gold, stone, silver.
Storey	1,135,790	(²)	Diatomite.
Washoe	1,168,853	1,120,215	Sand and gravel, stone, clays, gold, gem stones, silver.
White Pine	32,231,151	30,685,285	Copper, gold, molybdenum, lime, silver, stone, lead, sand and gravel, zinc, gem stones.
Undistributed [3]	[1] 137,953	1,291,920	
Total	[1] 80,335,000	80,565,000	

[1] Revised figure.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Includes some gem stones, mercury, silver, and gold that cannot be assigned to specific counties and values indicated by footnote 2.

A few tons of gold ore produced at the Desert Queen mine, *Desert* mining district, yielded recoverable gold and silver. A few ounces of silver was recovered from ore mined from the Nevada Hills property in the *Fairview* district. Tungsten ores mined at the Red Ant group, *Sand Springs* district, the Tungsten Mountain (Hilltop) mine, *Alpine* district, and the Fisk (Quick Tung) claims in the Stillwater Range were processed by the producers, and the concentrates were sold to a tungsten-carbide plant, Mineral County. The Red Ant and Fisk properties operated intermittently, while the Hilltop deposit was active throughout the year. Direct-shipping iron ore mined from the Iron Hat claims was consigned for export. Stockpiled iron ore concentrate from ore previously mined at the Buena Vista property was sold for export, except for a relatively small tonnage shipped for use as concrete aggregate in radiation shielding.

Clark.—U.S. Lime Products Division, The Flintkote Co., quarried high-calcium limestone near Apex and dolomitic limestone near Sloan. The raw minerals were used in making lime, sold for metallurgical flux, and sold to sugar refineries. The company operated lime plants at Apex, Sloan, and Henderson, utilizing six rotary kilns and two hydrators to produce quicklime and hydrated lime for a wide variety of construction, chemical, and other industrial uses. Dimension and crushed sandstone were shipped from a stockpile and quarry near Jean, owned by Diamond Gold Mining Co. The materials were used as rough and dressed architectural building stone and for roofing granules. Nearly 27,000 tons of granite was quarried in the southernmost section of the county and used in a Federal Bureau of Reclamation irrigation project. Variegated, banded, and vari-colored quartz from the Warren C. Scott Valley of Five quarries was marketed in the Las Vegas area for decorative building stone. Near Henderson, on land administered by the Bureau of Land Management, miscellaneous stone was quarried and used for roofing granules.

Approximately 1.8 million tons of sand and gravel was produced in the county during 1961, up from 1.5 million tons in 1960. Much of the year's output was consumed in building and paving projects in the Las Vegas area, including a Charleston Boulevard underpass, highway approaches to Las Vegas, and Interstate Route 15 between Las Vegas and Sloan. A highway project between Henderson and Boulder City and preliminary work at the new Las Vegas Air Terminal also consumed notable quantities of this material. An increased tonnage of sand and gravel was produced or purchased by Federal, State, county, and municipal agencies for use in roads. The Overton area was the principal source of silica sand produced and prepared for glass, molding, fire, furnace, and other industrial uses.

Crude gypsum was mined and calcined for plaster, lath, and wallboard by Blue Diamond Co., a division of The Flintkote Co., at Blue Diamond west of Las Vegas. A small tonnage of crude gypsum was shipped for use as cement retarder and for agricultural purposes. The Pabco Gypsum Division, Fiberboard Paper Products Corp., quarried gypsum at its deposit near Apex. The mineral was crushed, washed, centrifuged, dried, and shipped to company wallboard plants in California and to portland cement producers. Crude perlite from a Lincoln County deposit was expanded in a plant near Las Vegas and used as lightweight aggregate in plaster and concrete.

Manganese, Inc., for several years the largest domestic producer of manganese ore and the only large active manganese producer in Nevada, ceased operations about midyear. The company contract with the Federal government for manganese nodules ended in July. Before yearend all company holdings (plant and equipment), except land and mineral rights, were offered for sale. In its Henderson plant, American Potash and Chemical Corp. produced electrolytic manganese dioxide from domestic and foreign manganese ores. Approximately 60 percent of the recoverable lead and 5 percent of the zinc credited to Nevada producers was derived from lead residue produced by Manganese, Inc., as a byproduct in processing manganese ore. Copper and silver also were recovered from the residue. Zinc ore from the Argentena mine, *Goodsprings* district, yielded the rest of the recoverable lead and zinc in the county and much of the silver. The Copper King mine, also in the *Goodsprings* district was the source of the remaining copper recovered, plus a few ounces of silver. Gold ores from the Blossom, Red Bird, and Valley properties in the *Searchlight* district and the Capitol and San Francisco claims in the *El Dorado* district contained all the recoverable gold and the balance of the silver produced during the year. The Virgin Mountains beryl and chrysoberyl deposits south of Mesquite were explored by Beryllium Associates of Salt Lake City, Utah, and the Federal Bureau of Mines.

Douglas.—The Minnesota iron mine was worked by Standard Slag Co., and the ore was upgraded with magnetic separators. The entire plant output was shipped for export. Late in the year the company contracted for construction of an iron ore treatment plant near the mine. Planned plant capacity was 500,000 tons a year, and the plant was to incorporate crushing, magnetic separation, and sintering units. Completion was expected in April 1962. Silver ore mined at the Danite mine in the *Gardnerville* district yielded more than 200 ounces of silver. During the year the operator completed exploration and development comprising diamond, long-hole, and percussion drilling and some trenching and surface sampling. Ore taken from the Pennywinkle prospect in the *Mountain House* district contained recoverable gold.

Sand and gravel was produced by Savage Construction Co. and Nevada Contractors, Inc., in the Minden-Gardnerville area principally for use as concrete aggregate in building construction, and for highway construction near Topaz Lake and Spooners Summit by Silver State Construction Co. and Isbell Construction Co., respectively. State highway crews produced and used about 2,700 tons of sand for road maintenance in the county. Approximately 120 tons of miscellaneous stone was quarried by a contractor for the Nevada Highway Department for use as riprap.

Elko.—White & Alter, contractors, produced and prepared sand and gravel at a new plant in Elko, for use in local building construction. Jack B. Parson Construction Co. of Utah utilized pit-run and prepared gravel in construction of a section of State Highway 30 south of Montello. The company also quarried miscellaneous stone and used it for riprap on the same project. Maintenance crews for State, county, and municipal road agencies produced sand and gravel for their own use. Utah Construction & Mining Co. continued to explore for limestone north of the Pilot railroad siding and northwest of Wendover, Utah. Crude barite previously produced and stocked at the Rossi mine of National Lead Co.'s Baroid Division was shipped to company grinding facilities at Merced, Calif. The Estabrook Barite Co. also shipped stockpiled barite from its Marvel mine north of Carlin.

The Delno and Gold Note lead mines in the *Delano* district and the Nevada Lead (Killie) lead-zinc property in the *Spruce Mountain* district yielded all of the copper and lead and a high percentage of the silver and zinc recovered from ores mined in the county. Gold ore from the Nevada Gold mine near Midas was credited with virtually all the recoverable gold produced and more than 200 ounces of silver. The Starlight group of claims in the *Jarbidge* district yielded specimen gold and silver. Two mines in the *Ivanhoe* district, the Clementine and the Governor Group, yielded relatively small tonnages of cinnabar ore furnaced to recover mercury. Some ore from the Sheep Corral workings of the latter property was retorted to yield 2 flasks of mercury. Uranium ore from the South Fork property near Mountain City was shipped to a Utah processing plant.

Esmeralda.—Diatomite was mined and processed by Great Lakes Carbon Corp., Dicalite Division, near Basalt. The plant product was shipped out-of-State, principally for use as filler. Nevada's entire output of talc and soapstone was obtained from six deposits in Esmeralda County. Although the quantity produced was appreciably below 1960 production, the value of the output rose 10 percent as demand was for higher grade talcs. Crews of the State Highway Department produced sand and gravel for road maintenance. Western Silica Co. quarried and ground high-grade silica (opalite) at its Snowhite operation near the Nye County line south of Goldfield. The plant product was shipped chiefly to California customers.

U.S. Milling and Minerals Corp. closed its mines and its Silver Peak mill for an indefinite period on August 1. During the first 7 months of the year the company treated silver ores from the Mohawk, Ohio, and Weepah mines in the *Silver Peak*, *Hornsilver*, and *Lone Mountain* districts, respectively. Ores from these mines yielded most of the recoverable gold and silver produced in the county. American Exploration and Mining Co. concluded a development program on property leased from Goldfield Consolidated Mines Co. A small ore body, discovered during exploratory drilling, was mined before the lease expired on April 30. Ores mined from the Bristle Cone silver property near Dyer and the Sally Louise (Gold Eagle) lead-zinc mine in the Lone Mountain area contained recoverable silver, copper, lead, and zinc. Extensive exploration and development, aided appreciably by an OME loan, was completed at the latter mine. Some silver, lead, and zinc were recovered from ore produced at the Queen silver prospect in the *Buena Vista* district. The B & B and Red Rock open-pit mines in the *Fish Lake Valley* district yielded ores which were retorted and furnaced to recover mercury. The B & B mine yielded more than 200 flasks of mercury, but was closed indefinitely before yearend.

Eureka.—The Barth iron mine, near Carlin, was operated by Nevada-Barth Mining Corp. throughout the year. The mine was Nevada's major producer of direct-shipping ore. The entire output was shipped for export. Late in 1961, Utah Construction & Mining Co. investigated an iron ore deposit in the Thomas Creek area, south of Palisades.

The lead ore mined in the *Eureka* district by Consolidated Eureka Mining Co. contained most of the recoverable gold, silver, copper, and lead produced in the county and was one of only two sources of recoverable zinc. The company continued development on its property and made five shipments of lead ore to a Utah smelter during the year. The Mountain View zinc mine, in the *Lone Mountain* district, and the Blue Star gold property, in the Boulder Creek area north of Dunphy, were the only other metal mines in Eureka County yielding recoverable metal. An exploratory drilling program for lead-zinc ore was undertaken by New Jersey Zinc Co. about 5 miles southwest of Eureka, but the results were not made public. Extensive exploration of the Fish Creek beryl deposits south of Eureka was completed by Union Carbide Nuclear Corp.

Nacon Co., Inc., of Las Vegas, utilized pit-run gravel and prepared sand and gravel in surfacing a portion of U.S. Highway 50 southeast of Eureka. Miscellaneous stone was quarried near Palisades for use as railroad ballast for Southern Pacific Co.

Humboldt.—Ores mined and furnaced at the Cordero mine in the *McDermitt* (*Opalite*) district accounted for approximately 90 percent of the mercury produced and shipped in Nevada during 1961. Only one other mercury mine in the county, the Cahill in the *Poverty Peak* district, yielded more than 5 flasks of the metal. Ore from the Cahill mine was retorted.

Two mines in the Jackson Mountain area produced direct-shipping iron ore. Conversion of the Iron King open-pit mine to underground operation was completed early in the year, and 95 percent of the shipments were from underground production. About 40 percent of the output was shipped for export; the remainder was used in domestic iron and steel furnaces. The Red Bird open-pit operation was shut down in April because of a major slide. About one-half of the iron ore from this mine was exported to Japan and the other half shipped to domestic furnaces. Getchell Mine, Inc., shipped from stock about 24,000 units of tungsten trioxide (WO_3) in the form of tungsten concentrate that had been produced from ores mined in previous years. The concentrate was shipped to Union Carbide Nuclear Co. at Pine Creek, Calif. Getchell scheduled reactivation of the Getchell gold mine for early 1962 following extensive exploration and development in 1961, and was altering its tungsten mill to treat gold ores. Lode gold and silver output in 1961 was limited to cleanup operations at several old mines in the *Awakening* district and to a few ounces of gold recovered from 20 tons of ore mined in 1960. Placer gold and silver were recovered by washing ancient riverbed gravels in the *Sulphur* district and a few miles from Black Horse.

Pit-run and prepared sand and gravel was produced by Silver State Construction Co. of Fallon, Churchill County, for use in surfacing about 13 miles of Interstate Route 80 over the Golconda Summit and by Ready-Mix Concrete Co. of Reno, Washoe County, for a highway project north of Orovada. State and county highway crews produced more than 8,000 tons of sand and gravel for use in road maintenance. Sandstone quarried by Wegman Bros., Contractors, from the Wadsworth claim near Denio, was sawed in the producer's plant in Winnemucca for use as architectural building stone. Crude barite was mined at the Little Britches property (a new producer) and shipped to a California grinding plant. Over 600 tons of sulfur ore was mined at the Crofoot property, but only a few tons of the material was shipped, chiefly for agricultural use.

Lander.—Magnet Cove Barium Corp. operated its Battle Mountain grinding plant on crude barite mined from its Greystone and adjacent claims. The plant product was shipped to company facilities in Texas. Four other barite properties were active during the year—the Argenta and Shelton mines and the Yuba claims in the *Argenta* district, and the Mountain Springs deposit south of Battle Mountain. Crude barite from the latter was shipped to the producer-owned chemical plant of Mineral Products Division, FMC Corp., at Modesto, Calif. Milwhite Mud Sales operated the Argenta property and shipped to a grinding plant near Sacramento, Calif. The Shelton family worked the other two deposits and shipped to grinders in California and Montana.

A new iron ore property went into production in 1961. The McCoy mine, near the old Hancock mine in the *McCoy* district, idle since 1952, was activated by A R D Equipment Co. in February. The magnetite ore mined during the year was shipped to Japan. London Extension Mining Co. closed its Goldacres open-pit mine March 31, after continuous operation since 1934, marking the end of Nevada's straight lode-gold mining. The 450-ton-a-day cyanide mill was shut down June 15, and an auction of all equipment, including machinery structures, was held December 11. Some gold and silver were recovered by amalgamation from ore mined at the New Pass (Thomas W.) mine at New Pass, and a small tonnage of silver ore and mine dump material containing recoverable silver, copper, lead and zinc was shipped from the Silver Chief claims near Battle Mountain to the smelter at Shelby, Calif. Copper ore from the Copper Canyon property and dump material from the Copper Queen mine in the *Battle Mountain* district yielded considerable copper and a few ounces of silver. The Lynch Creek beryllium-tungsten deposit south of Austin was explored by the Federal Bureau of Mines. Gold and silver were recovered from stream gravels at the Dahl placer property, *Battle Mountain* district. The gravels were worked by drift mining.

Crews for State and county highway agencies produced sand and gravel for use in road maintenance. Maintenance crews for the Bureau of Land Management quarried a relatively small tonnage of stone for constructing retaining walls.

Lincoln.—Crude perlite was mined at the Hollinger pit near Pioche, and, except for a comparatively small tonnage expanded for lightweight aggregate in a Clark County plant, the mineral was shipped to out-of-State customers. Perlite also was mined at the Delamar deposit southwest of Caliente and shipped to a California expanding plant. High-purity silica sand was produced about a mile north of Cathedral Gorge. The sand was processed at Panaca by J. G. Shotwell, Inc., and trucked to the construction site of Glen Canyon Dam at Page, Ariz. The material was used as pozzolan in concrete and supplemented the output from the producer's Flagstaff, Ariz., plant. The Wilkin pit near Pioche was the source of sand and gravel for local concrete, paving, and construction needs. Prepared and pit-run sand and gravel were produced and used in surfacing U.S. Highway 93 south of Pioche, by Whiting Bros. Construction Co. of Las Vegas, Clark County. A contractor for Union Pacific Railroad Co. quarried and crushed miscellaneous stone near Caliente for use as railroad ballast. Metallurgical-grade fluorspar was mined and shipped from the Carp mine stockpile to a California steel plant. A relatively small tonnage of diatomite was mined at Panaca and shipped to a manufacturer of stock-feed supplements.

Of four metal mines operating all or part of 1961, the Bristol mine, *Jack Rabbit* district, was the major producer, yielding copper ore from which a high percentage of the county's gold, silver, copper, lead, and zinc was recovered. Lead ore from the Hamburg mine, *Pioche* district, also contained recoverable quantities of each of these metals. The ores produced at these mines were shipped to a Utah smelter, as was gold ore from the Atlanta mine, *Atlanta* district, and silver ore from the Tempiute mine, *Tempiute* district. The Hoover Construction Co. of Minnesota completed a sampling and development contract at the Atlanta property.

Lyon.—Production of oxide copper ore from the Yerington mine of The Anaconda Company continued at a normal rate through October and at a reduced rate for the remainder of the year. October marked the start of sufide copper ore treatment in the new sulfide concentrator, which was operating at a rated capacity of 5,000 tons of ore a day at yearend. The Yerington mine was the county's major mining operation and the State's second largest copper producer. During the year Bear Creek Co., Division of Kennecott Copper Corp., terminated exploration for copper ore in the Yerington area. Utah Construction & Mining Co. completed its evaluation of the Dayton iron deposit and planned to develop the property for production at an early date. An iron property in the Pumpkin Hollow area was explored by Columbia Iron Mining Co. through rotary drilling. About 50 tons of uranium ore was shipped from a deposit on the Strosnider ranch, on the East Walker River south of Yerington, to a Utah processing plant. The grade of the ore was not reported.

Diatomite mined by Aquafil, Co., Division of Kohl Enterprises, Inc., in Churchill County, was processed in the producer's plant at Fernley. The plant products were shipped to out-of-State customers. Carson Ready-Mix, Inc., and John L. Savage Construction Co. worked sand and gravel deposits in the Dayton area and prepared aggregate for concrete in their Ormsby County plants at Carson City. The latter company used pit-run and prepared sand and gravel in construction of a secondary highway near Yerington. Eckley Construction Co. prepared sand and gravel from a deposit near Smith for surfacing a section of State Highway 3. State highway crews produced about 8,000 tons of sand and gravel and used the material for road maintenance. Seaforth-Nevada Corp. quarried miscellaneous stone near the Ormsby County line northeast of Carson City for use as building stone and roofing granules. Fuller's earth was shipped from a stockpile at the Juniper pit near Weeks by Industrial Minerals & Chemical Co. The material was used in preparing livestock feed pellets and for various other uses.

Mineral.—Humboldt Ore Co. worked the Iron Gate mine 4 miles east of Luning and consigned the direct-shipping-grade ore for export. The company opened this property in 1960 after it had been idle since 1952. Several hundred tons of iron ore was shipped from the Madallena property in the Cedar Mountain area east of the Iron Gate mine. The operation was not profitable, and it was shut down before yearend. Pacific States Steel Co. explored the Black Horse iron claims by rotary drilling and stripping. The property is near the summit of the Gillis Range between Hawthorne and Luning. Antimonial lead ore containing recoverable gold, silver, copper, lead, and zinc was shipped to a Utah smelter from the New Potosi mine in the *Candelaria* district. Gold and silver were recovered from ore produced at the Douglass mine in the *Silver Star* district. Dump material from the Live Yankee and Sitting Bull claims in the *Aurora* district was treated to recover gold and silver. Nevada Scheelite Division, Kennametal, Inc., operated its tungsten carbide plant near Rawhide on tungsten concentrates previously produced by the company and those purchased from other producers. A relatively small quantity of tungsten concentrate, mined and milled in 1957 at the Slim Pickens group of claims near Bald Mountain on the west side of Walker Lake, was sold to Nevada Scheelite. The Desert Scheelite property 28 miles northeast of Mina was idle except for assessment work.

Three barite properties were operated. Crude barite from the Columbus (Noquez) and Little Summit (Giroux) mines south of Belleville Mountain was shipped to Harbor City, Calif. Barite produced at the Lucy claims, a new property, in the Nolan area, on the east side of Walker Lake, was shipped to a processor near Sarcramento, Calif. Sonora Marble Aggregate Co. quarried and prepared marble near Luning for use as terrazzo. Pumco Aggregate mined volcanic cinder from a deposit near Mina and prepared the material for use as lightweight concrete aggregate.

Nye.—Magnesite was mined in the Gabbs area by Basic, Inc., and Standard Slag Co. Both companies operated processing plants to produce caustic-calcined and refractory magnesias, in addition to various other products for the refractories industry and consumers of magnesium compounds. Basic, Inc., which completed a $2 million plant expansion in 1961, upgraded magnesite by flotation and brucite by heavy-medium separation. The company sold to a California producer of epsom salt a relatively small quantity of brucite that had been mined in 1959. The crude mineral was upgraded for sale and for company use. Standard Slag Co. mined iron ore from its nearby Iron Mountain property. The ore was consumed in the Gabbs magnesite plants in producing dead-burned magnesia. A new iron property (Eddy) was opened in the Sherman Peak area north of the Iron Mountain mine. All ore from the Eddy was shipped to a Texas steel plant.

Wells at the Eagle Springs field of Shell Oil Co. yielded the State's entire crude petroleum output. The marked increase in production over 1960 was due almost entirely to a well completion early in 1961.

Metallurgical-grade fluorspar produced at the Crowell (Daisy) mine near Beatty was shipped to west coast steel mills. Crude fluorspar mined at the Goldspar property by Monolith Cement Co. was consumed in the producer's California plant. Over 31,000 tons of sand and gravel was produced and prepared by Dodge Construction, Inc., of Fallon, Churchill County, for highway construction near Warm Springs. Winter weather suspended the work before the project was completed. Crews of State and county road agencies produced sand and gravel for use in highway maintenance. Approximately 90,000 tons of sand and gravel, produced and prepared under contract for the U.S. Atomic Energy Commission in 1960, was utilized in construction of roads and various structures and facilities at the Nevada Test Site in southern Nye County. Volcanic cinder was excavated from a hillside deposit near Beatty and used as lightweight aggregate by a Clark County building block producer. Bentonite dug at the New Discovery mine near Beatty was shipped for use in the preparation of pharmaceuticals.

Five mercury properties were active; however, only two had output exceeding a dozen flasks. The Horse Canyon mine near Manhattan, operated by Gabbs Exploration Co., was the major producer. Cinnabar ore from this mine was furnaced to yield over 200 flasks of mercury. The operator reported that the mine was closed September 21. The Ione mercury mine, *Union* district, was operated by LDC Mining, which also furnaced ore to recover the metal. Ores from the Redbird claims, *Belmonth* district, and the Nevada Cinnabar and Yellow Cat mines, *Union* district, yielded a few flasks of mercury. Tungsten concentrates from previously mined and milled ore at the Jewel mine in the Gabbs area and the Nye tungsten property in the Grant Range south of Currant were shipped to the tungsten carbide plant in Mineral County. A few tons of tungsten ore, mined at a prospect in the *Gabbs* district, was processed, and the resulting concentrate was shipped to the same Mineral County plant. Gold ores from two properties, one each in the *Bullfrog* and *Johnnie* districts, and silver ores from two mines, one each in the *Danville* and *Tonopah* districts, were operated for brief periods during the year to recover the respective metals. The Faye group of silver claims in the *Lodi* district, a few miles east of Gabbs, was the source of a few tons of ore containing recoverable silver, copper, lead, and zinc. Stream and bench gravels were worked in the *Manhattan* and *Round Mountain* districts, chiefly by small-scale hand methods, to recover placer gold and silver. A nonfloating washing plant was operated on the Nevada Porphyry property at Round Mountain and recovered most of the county's placer gold and silver. Cleanup operations at the Round Mountain dredge at the same location also yielded a few ounces of gold and silver.

Ormsby.—The Carson City Cinder Lite volcanic cinder deposit near the Carson City airport was worked by Reno Ready-Mix Concrete Co., which used the material for lightweight aggregate in making building block. Sand and gravel was produced near New Empire and prepared for building and paving use by John L. Savage Construction Co. State highway crews produced sand for road maintenance.

During the year an iron ore deposit was opened in the Brunswick Canyon area of the *Delaware* district by Seaforth-Nevada Corp. Several thousand tons of magnetite ore from this property was shipped by rail to the port of Stockton, Calif., for export to Japan.

Pershing.—Eagle-Picher Co. mined diatomite in the Trinity Mountain area and processed the material in the company plant at Colado. The plant products were sold for a wide variety of industrial uses. United States Gypsum Co. mined crude gypsum at its Empire quarry near Gerlach at the Washoe County line. The crude mineral was moved by overhead tram to the Empire mill and board plant across the county line. This plant also received crude perlite from its Pearl Hill quarry northwest of Lovelock. The perlite was crushed and sized at Kodak siding near Lovelock before shipment to Empire. Crews and contractors for State and county highway agencies produced and utilized pit-run an prepared sand and gravel for road construction and maintenance. Dodge Construction Co. quarried miscellaneous stone for use as riprap in highway construction.

Six iron mines in the Buena Vista Hills area, southwest of Lovelock, were active, and all yielded direct-shipping-grade ore. About 45 percent of the total output was shipped for export; the remainder was consigned to various domestic iron and steel plants. Dodge Construction Co., which worked the Iron Horse group (sec. 31, T. 26 N., R. 34 E.), the Ford prospect (sec. 6, T. 25 N., R. 34 E.), and the Thomas mine (sec. 29, T. 26 N., R. 34 E.), was the major producer. Nevada Iron Ore, Inc., which had various independent operators under lease in section 29, was the second largest producer. B. W. Van Voorhis, Jr., worked the Segerstrom-Heizer mine (sec. 15, T. 25 N., R. 34 E.), and W. M. Fisk mined the Phoenix group (sec. 10, T. 25 N., R. 34 E.). Both produced magnetite ore for export; however, Van Voorhis made some shipments to domestic steel mills. Consolidated Minerals Corp. shipped stockpiled iron ore that had been mined in section 16 (T. 25 N., R. 34 E.) during 1960. Dodge Construction Co. was the only producer that was active the entire year. The I Wonder property in the *Juniper* district and the Wizard group of claims near Nixon each yielded about 1 ton of tungsten concentrate which was sold to Kennametel, Inc., Mineral County. Although five mercury properties were active during the year, only one, the Freckles (Roman) in the Table Mountain area, reported a yield of more than 3 flasks of mercury. Simpson and McKenzie worked the Freckles mine and furnaced cinnabar ore to recover over 200 flasks of mercury. Three lode-gold properties in the *Seven Troughs* district were worked to produce small tonnages of ore containing recoverable gold and silver. A nonfloating washing plant in the *Willow Creek* district treated stream gravels to recover placer gold and silver. Gravels worked by small-scale hand methods in the *Rabbit Hole* district also yielded a few ounces of gold and silver.

Storey.—About 38 percent of Nevada's diatomite production was obtained from the Celatom open-pit mine, owned and operated by Eagle Picher Co. The crude material was crushed, dried, calcined, and classified in the company plant at Clark Siding. Plant products were shipped for use in insulation, as an abrasive and filler, and for a wide variety of other industrial uses.

The Gooseberry (Martin) gold-silver mine in the *Ramsey* district south of Clark Siding was the scene of exploration and development, but no ore was reported mined or shipped.

Washoe.—The output of sand and gravel at commercial plants and by Government crews and contractors totaled nearly 1.2 million tons. The demand for aggregate used in paving streets, highways, and airstrips was substantially above 1960 figures and more than offset the lower production of sand and gravel for building construction. The major producers operated preparation plants along the Truckee River in the Reno area. The quantity of sand and gravel needed for maintenance of State and Federal highways was lower, but county roads required a much larger tonnage than in 1960. A comparatively small quantity of decomposed granite was quarried by crews and contractors for the city of Reno. The material was used as fill under sewer line and as road base. Double Check Products Co. shipped calcareous marl from a stockpile at its deposit 5 miles east of Flanigan. The marl was processed for use in poultry and livestock feeds in a California plant. Pacific Fertilizer Co., Inc., worked a marl deposit 5 miles northeast of Pyramid Lake and prepared the mineral for use as a soil conditioner and deodorizer of organic wastes (fertilizers). In the Nixon area, exploration was underway for limestone and a possible lime plant site. Reno Press Brick Co. mined fire clay and miscellaneous clay at its Faith and Geiger pits near Steamboat Springs and at its Revelation pit near Sparks. United States Gypsum Co. operated its Empire plaster mill and wallboard plant on crude gypsum received from the company's nearby quarry in Pershing County. The company also expanded perlite received from its Pearl Hill quarry near Lovelock, Pershing County.

Two lode-gold properties in the *Olinghouse* district, the Sunbeam and the Dondero, produced relatively small quantities of gold and silver. Some exploration and development was conducted at the Renegade mine and Barber claims, but no production was reported.

White Pine.—Copper ores mined in the *Robinson* district were the principal source of recoverable copper, gold, and silver. Kennecott Copper Corp. worked the Liberty pit and transported the ore and stockpile ore from the Tripp and Veteran pits to the company concentrator and smelter at McGill. These copper ores also were the source of the State's entire output of molybdenum, which was recovered as a byproduct in the form of molybdenum concentrate by flotation at the concentrator. The company quarried limestone near McGill to produce lime used in the concentrator. Some of the limestone was utilized as railroad ballast on the company-owned rail line and in maintenance of company-owned roads. The quarry and lime plant were closed on December 16, and plans were made to purchase future lime requirements. Kennecott carried on extensive exploration at the Liberty pit during the year, and its Bear Creek Mining Co. division terminated a copper exploration project in the Lane City area. The Kansas mine in the *Aurum* district was the source of copper ore yielding copper and silver. Exploratory drilling for copper was in progress in the *White Pine* district by Homestake Mining Co. Only subcommercial mineralization was discovered, and the project was abandoned late in the year. In the same district lead ore that contained recoverable gold, silver, copper, lead, and zinc was shipped from the Hamilton mine. These metals also were recovered from silver ore mined at the Ward (Mammoth) group in the *Ward* district. A comparatively small quantity of silver ore obtained from the Grey Lady property in the *Taylor* district yielded silver, lead, and zinc. The Willard mine in the *Robinson* district was worked, and zinc ore containing recoverable gold, silver, lead, and zinc was shipped. The Anaconda Company completed extensive underground exploration for beryllium ore at the Mount Wheeler and Jeppson properties in the Mount Washington area.

Quartzite was quarried 12 miles north of Baker by Star Dust Mines and shipped for use as dimension building stone in construction of the Brigham Young University library at Provo, Utah, and in the First Federal Savings & Loan building in Summit, Ill. Angelo Reck operated a portable gravel plant near Ely to produce paving materials for local use. Paving sand and gravel also was produced by a contractor for Lehman Caves National Monument and by State highway crews for road maintenance.

The Mineral Industry of New Hampshire

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the New Hampshire State Planning and Development Commission.

By Stanley A. Feitler[1] and Mary E. Otte[2]

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MOST ELEMENTS of the mineral industry maintained a satisfactory rate of output during 1961, although the total value of mineral production was 2 percent below the record high of 1960. Mineral raw materials used for highway and building construction and strategic-grade mica purchased by the Federal Government accounted for 98 percent of the $5.4 million production during 1961. In the 10 years since 1951, value of mineral output increased 177 percent. Most of the increase was attributed to growth in value of sand and gravel and mica. The expanded State-and-Federal highway construction program was responsible for much of the increase in sand and gravel totals, but improved canvassing accounted for part of the increase in the reported totals.

TABLE 1.—Mineral production in New Hampshire[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate..........short tons..	14	$8	23	$14
Clays..........do....	27,260	27	29,810	30
Feldspar..........do....	(2)	(2)	10,290	62
Gem stones..........	(3)	15	(3)	(2)
Mica:				
Sheet..........pounds..	[4] 72,188	[4] 1,101	62,737	931
Scrap..........short tons..	415	14	669	20
Peat..........do....	23	(2)	15	(2)
Sand and gravel..........thousand short tons..	6,621	3,687	7,701	3,627
Stone..........short tons..	104,105	594	116,920	684
Value of items that cannot be disclosed: Values indicated by footnote 2..........	....	68	....	20
Total New Hampshire..........	....	[4] 5,514	....	5,388

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Weight not recorded.
[4] Revised figure.

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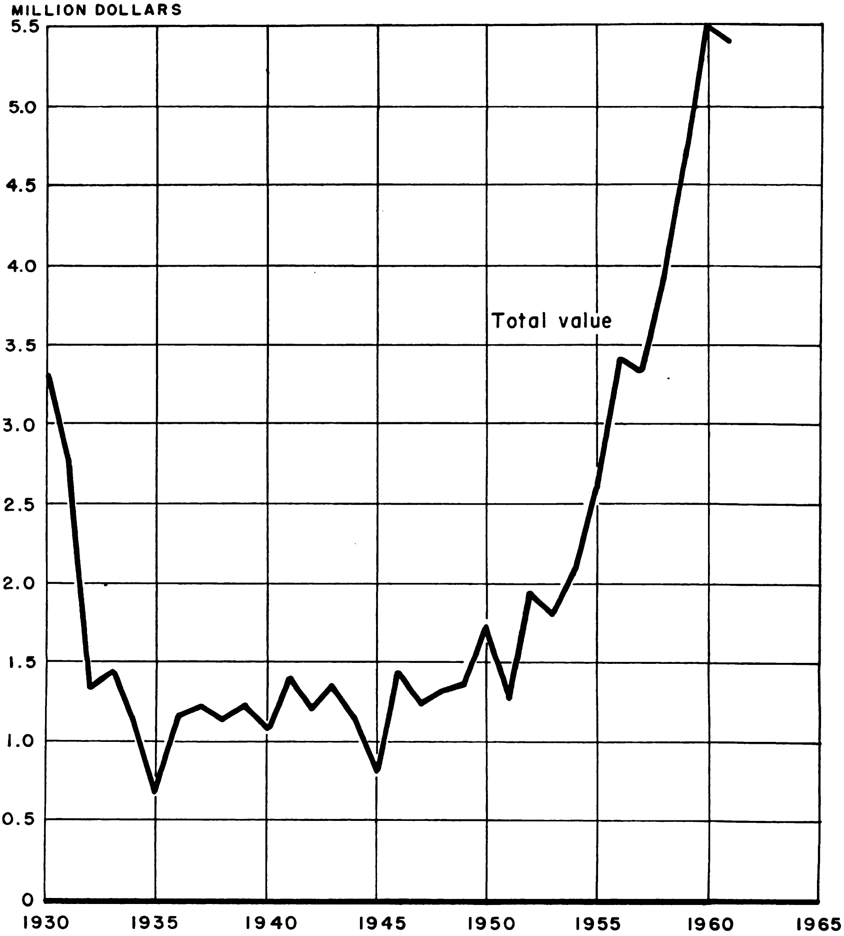

FIGURE 1.—Value of mineral production in New Hampshire, 1930–61.

Legislation and Government Programs.—The Government purchase program was scheduled to end when 25,000 tons of mica had been acquired, but not later than June 30, 1962. One ton was charged against the quota for each ton of hand-cobbed or 90 pounds of full-trimmed mica purchased by General Services Administration (GSA). By carefully sorting out poor mica, a ton of hand-cobbed may yield much more than 90 pounds of full-trimmed mica. To sell as much strategic mica as possible and to avoid filling the quota before June 30, 1962, the larger New Hampshire producers had, with few exceptions, sold their output under the "B" or hand-cobbed option since 1959.

The decline in the value of mica sold to the Government each year since 1959 was caused by depletion of known ore bodies. Because the nearness of the end of the mica purchase program left little opportunity to recoup exploration costs, the search for new ore bodies to replace those worked out was discouraged. Few, if any, of the

New Hampshire mines from which mica was produced for the purchase program could be operated profitably to sell sheet mica at world prices.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Miscellaneous clay for manufacturing building brick was mined at two pits in Rockingham County and one pit in Grafton County. Output was 10 percent more than in 1960. Brickyards operated in conjunction with the clay pits burned about 12 million building brick.

Feldspar.—Crude feldspar from pegmatites in Cheshire and Grafton Counties was beneficiated and ground at the Golding Keene Co. Alstead mill. Production of finely ground potash feldspar was approximately the same as in 1960. The output was used in pottery, insulators, tile, and enamel, and as an abrasive. The principal consumers were in New York, New Jersey, Massachusetts, Connecticut, and Ohio. Average value of the ground feldspar increased compared with 1960.

Gem Stones.—Mineral collecting continued to be popular, and New Hampshire's pegmatite and other mineral localities yielded much specimen material and some gems. Gem and mineral specimens were recovered as byproducts from pegmatites being mined for mica, feldspar, and beryl in Grafton and Cheshire Counties.

Mica.—Sheet mica production continued at a high level, although it was less than in 1960. Tonnage and value of scrap mica was substantially higher in 1961 than in either of the 2 preceding years. Most of the sheet mica was of strategic quality and was purchased by the GSA depots in Franklin, N.H., Spruce Pine, N.C., and Custer, S. Dak. Full-trimmed mica was sold at an average price of $14.80 per pound, 4 percent higher than 1960. Higher quality hand-cobbed mica was sold to GSA in 1961, as the average price per pound was $0.77 compared with $0.74 in 1960.

Sales of mica were reported mainly from Grafton and Cheshire Counties. Although mica was recovered from several mines in Sullivan and Merrimack Counties in previous years, only one mine was worked in Sullivan County during 1961.

Wet-ground mica production increased during the year; the average value was about the same as in 1960. The finely ground material was used in the manufacture of paint, wallpaper, and rubber. More than 60 percent of the scrap mica used for grinding was imported; the rest was domestic scrap and flake produced in trimming sheet mica.

Peat.—Reed-sedge peat produced in Belknap County was sold for use as a soil conditioner.

Sand and Gravel.—Tonnage of sand and gravel increased 16 percent, but the value decreased 2 percent. Output by commercial producers was 5 percent less in quantity and 13 percent less in value than in 1960. More commercial sand and gravel for building was sold at a higher average price; sales for paving were lower, but the price was about the same as in 1960. The quantity of material sold for fill and miscellaneous uses increased significantly, but the average price per ton was down 34 percent.

The output of one noncommercial operation, begun during the year in Strafford County, was responsible for the net increase in the tonnage of sand and gravel in the State during 1961. Bank-run material loaded into railroad cars in the pit was shipped to Boston, Mass., for use as fill in highway construction. A favorable railroad freight rate based on large daily shipments and low production costs made this out-of-State material competitive with that produced in the Boston area. This operation presented a method of ameliorating the unfavorable effect of zoning on availability and price of sand and gravel in urban areas.

Government-and-contractor operations produced unprocessed sand and gravel, representing 75 percent of the tonnage and 56 percent of the value in 1961. The quantity of sand and gravel used in New Hampshire was 2 percent less than in 1960; 1¼ million tons was shipped to Massachusetts. Crews of the Concord Commissioner of Public Works, Merrimack County, and the Manchester Highway Department, Hillsboro County, produced sand and gravel for highway construction and maintenance.

TABLE 2.—Sand and gravel, and stone production by Government-and-contractor operations, by counties

(Short tons)

County	Sand and gravel		Stone	
	1960	1961	1960	1961
Belknap	102,539	128,754	1,920	----------
Carroll	105,547	123,182	----------	----------
Cheshire	302,023	219,954	4,444	1,261
Coos	243,483	248,475	998	1,033
Grafton	518,844	1,024,562	12,880	7,251
Hillsboro	367,181	856,442	1,027	11,817
Merrimack	1,007,533	810,341	11,353	841
Rockingham	250,588	537,830	206	1,492
Strafford	131,453	1,346,347	----------	----------
Sullivan	448,432	481,255	223	8,800
Total	3,477,623	5,777,142	33,051	32,495

Stone.—Output of stone increased 12 percent in tonnage and 15 percent in value. Dimension stone made up most of the value. Dressed architectural stone and grave markers prepared from New Hampshire granite were in demand, and production increased. The finishing plant of The John Swenson Granite Co., Inc., Merrimack County, processed crude blocks of granite from its nearby Gray quarry, its Pink and Green quarries in Maine, and the Woodbury quarry in Washington County, Vt. Crushed granite for riprap and fill was produced in seven counties by crews of the New Hampshire Department of Public Works and Highways. Miscellaneous stone was mined and prepared for use as riprap, concrete aggregate, and roadstone.

METALS

Beryllium.—Recovery of hand-cobbed beryl was greater than in 1960. Beryl purchased for the national stockpile by GSA at its Franklin, N.H., depot had an average value of 29 cents per pound and beryllium oxide content of 11.66 percent. Beryl was recovered at 10 mines in 4 counties, but most of the tonnage was from Cheshire and Grafton Counties.

REVIEW BY COUNTIES

Sand and gravel and stone produced by Government-and-contractor operations were shown by county in table 2 and are therefore not included under the individual county reports that follow.

Belknap.—Sand and gravel produced at the Tilton plant of Tilton Sand & Gravel, Inc., was sold for building, paving, and fill. Reedsedge peat, recovered from a bog near Barnstead by Perking Peat Bog, was sold in bulk form.

Carroll.—Building and paving sand and gravel were produced by Sparks Construction Co., Ossipee, and Alvan J. Coleman, Conway. Gem stones and mineral specimens recovered from pegmatites and other mineral localities included beryl, aquamarine, tourmaline, topaz, quartz crystals, and microcline. Beryl from the Chandler mine near Chatham was sold to GSA at Franklin.

TABLE 3.—Value of mineral production in New Hampshire, by counties

County	1960	1961	Minerals produced in 1961, in order of value
Belknap	(1)	(1)	Sand and gravel, peat.
Carroll	$83,020	(1)	Sand and gravel.
Cheshire	[2] 727,090	$670,220	Sand and gravel, mica, beryllium, feldspar, stone, gem stones.
Coos	177,713	112,998	Sand and gravel, stone.
Grafton	[2] 1,405,905	1,411,166	Mica, sand and gravel, feldspar, clays, stone, beryllium, gem stones.
Hillsboro	(1)	605,991	Stone, sand and gravel.
Merrimack	1,374,698	1,378,045	Sand and gravel, stone, gem stones.
Rockingham	323,641	(1)	Sand and gravel, clays, stone.
Strafford	(1)	365,562	Sand and gravel.
Sullivan	222,389	200,826	Sand and gravel, stone, mica, beryllium.
Undistributed [3]	[2] 1,199,609	642,703	
Total	[3] 5,514,000	5,388,000	

[1] Figure withheld to avoid disclosing individual company confidential data.
[2] Revised figure.
[3] Includes value of beryllium, gem stones, and mica not assigned to specific counties and value indicated by footnote 1.

Cheshire.—Sand and gravel for building, paving, and fill was produced by Cold River Sand & Gravel Corp., North Walpole, and Keene Sand & Gravel, Inc., Swanzey. The county continued to rank second in sheet mica production with an increase of 9 in quantity and 38 percent in value. Most of the hand-cobbed and full-trimmed mica was sold to the Government through the GSA purchase depot, Franklin, but some was delivered to the Spruce Pine, N.C., and Custer, S. Dak., purchase depots. Two producers reported sales of mica to industry. Twelve mines, four near Gilsum and eight near Alstead, yielded sheet and scrap mica.

Output of beryl increased markedly in 1961. The Golding Keene Co. produced most of the tonnage from the Clarke mine near Alstead. The Isham mine near Gilsum also yielded beryl. Crude mixed feldspar recovered at the Colony mine by Golding Keene Co. was delivered by truck to the company's nearby Alstead mill. The crude feldspar was beneficiated and ground for use in the manufacture of insulators, floor tile, enamel, abrasives, and pottery. Fluorite was collected near Westmoreland, and a variety of minerals and gem stones was recovered at pegmatite localities near Gilsum.

Coos.—Gravel for fill and railroad ballast was recovered near Colebrook by Clyde B. Gray and the Maine Central Railroad Co. Lessard Sand & Gravel Co., Gorham, and Fred Corrigan, Randolph, produced sand and gravel for paving and fill.

Grafton.—Grafton County ranked first in value of mineral production in the State. The county again led in sheet mica production despite a continued decline in quantity and value (21 and 24 percent, respectively). Twenty-nine mica producers operated 17 mines during the year, mainly in Groton, Grafton, and Orange Townships. All hand-cobbed and full-trimmed sheet mica was sold to the Government in 1961. The average price of sheet mica was $17.80 per pound, compared with $18.40 in 1960. Some scrap mica also was produced. Ruggles Mining Co. produced hand-cobbed feldspar at the Ruggles mine for Golding Keene Co. Golding Keene Co. also produced feldspar at the Ruggles mine. The combined output was shipped to the Golding Keene grinding plant at Alstead, Cheshire County, for processing. Beryl was recovered from six mines and sold to GSA at Franklin. The Ruggles mine near Grafton yielded most of the tonnage.

Sand and gravel recovered near West Lebanon, Plymouth, Campton, and Littleton was used mainly for building and paving. Miscellaneous clay recovered from an open pit mine by Densmore Brick Co., Lebanon, was used for making building brick. Amateurs and dealers continued to recover gem and mineral specimens during the year. Among the mineral specimens collected were beryl crystals, graphite, mica, and clevelandite.

Hillsboro.—Commercial sand and gravel, used chiefly for building and paving, was produced by J. J. Cronin Sand & Gravel and Robie Construction Co., Inc., both near Manchester, and The Harris Construction Co., Inc., Peterborough. Kitledge Granite Corp. quarried dimension granite at the Kitledge quarry near Milford and sold the stone for use as monuments.

Merrimack.—The county continued to lead the State in commercial sand and gravel production. Manchester Sand, Gravel & Cement Co., Inc., Hooksett, produced sand and gravel chiefly for building and paving. The John Swenson Granite Co., Inc., Concord, quarried granite at its Gray quarry and produced dressed architectural stone and curbing. The company also sold granite for use as riprap and concrete aggregate. Gem and mineral specimens were collected in the county.

Rockingham.—Gravel, used chiefly for fill, was produced by L. Chester and Clayton W. Simpson, near Exeter. W. S. Goodrich, Inc., Epping and Eno Bros. Brick Co., Exeter, mined miscellaneous clay for use in manufacturing building brick. Iafolla Crushed Stone Co., Inc., Portsmouth, quarried and prepared crushed stone for use as riprap, concrete aggregate, and roadstone.

Strafford.—Building sand and gravel and miscellaneous gravel were produced at Durham by James S. Pike and at Dover by Dover Sand & Gravel, Inc.

Sullivan.—Hand-cobbed mica recovered from the Brooks mine by Raymond Johnson was sold to GSA at Franklin. Collectors continued to recover gem stones and mineral specimens.

The Mineral Industry of New Jersey

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the New Jersey Division of Resource Development, Bureau of Geology and Topography.

By Joseph Krickich,[1] Stanley A. Feitler,[2] and Mary E. Otte[3]

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ALTHOUGH output of one New Jersey major mineral product—iron ore—continued to decline, the overall value of mineral production resumed its upward trend in 1961. The $2.8 million increase over 1960 was attributed mainly to greater demand for stone and sand and gravel, reflecting increased activity in highway and building construction. Slight to moderate increases in value were reported for all other commodities except magnesium compounds, marl, and iron ore.

TABLE 1.—Mineral production in New Jersey[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons..	664	$1,597	657	$1,681
Gem stones	(2)	7	(2)	9
Peat .... short tons..	25,100	192	21,257	212
Sand and gravel .... thousand short tons..	11,594	19,511	12,257	20,895
Stone .... do..	10,202	22,814	11,315	24,539
Zinc [3] (recoverable content of ores, etc.) .... short tons..	....	....	112	26
Value of items that cannot be disclosed: Iron ore, lime, magnesium compounds, manganiferous residuum, marl (greensand), and uranium (1960). Excludes limestone and oystershell used in manufacturing lime.	....	12,288	....	11,846
Total New Jersey	....	56,409	....	59,208

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Recoverable zinc valued at the yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

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[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2] Mining engineer, Bureau of Mines, Pittsburgh, Pa.
[3] Statistical clerk, Bureau of Mines, Pittsburgh, Pa.

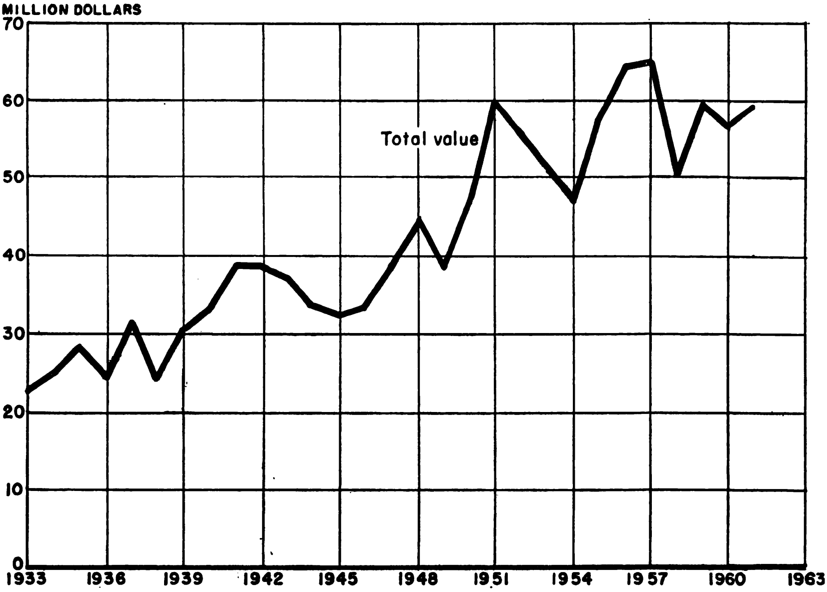

FIGURE 1.—Total value of mineral production in New Jersey, 1933–61.

Trends and Developments.—Iron mining was curtailed in Morris County. Production of zinc concentrate was resumed in Sussex County at the Sterling mine which had been idle since 1958. A number of new installations affecting the mineral industry were in operation, under construction, or planned during the year. Minnesota Mining and Manufacturing Co. began producing artificially colored roofing granules in Somerset County. Under construction were the Glidden Co. ilmenite-concentrating plant in Ocean County and a synthetic mica-manufacturing unit by Electronic Mechanics, Inc., in Passaic County. Flintkote Co. acquired property in Camden County and completed plans to build a plant for processing crude gypsum mined in Canada.

National Lead Co. began constructing a large research facility in Mercer County. Equipment was installed by Metals & Residues, Inc., in Union County, and by American Smelting and Refining Company to expand production of high-purity metals such as tungsten, molybdenum, and various byproducts of copper, lead, and zinc smelting and refining.

Employment and Injuries.—Employment in the State mineral industries as indicated by preliminary data declined 12 percent, owing mainly to decreased activity at smelters and coke ovens. In addition, employment decreased for all other categories as shown in table 2. Injury experience improved; lower frequency rates were reported for all segments of the mineral industry. Only one fatality was reported, compared with two in 1960.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	Men working daily	Man-hours worked	Injuries		
			Fatal	Nonfatal	Per million man-hours
1960:					
Sand and gravel	1,034	2,075,988		35	17
Quarries and mills	923	1,790,710		89	50
Nonmetal mines [2]	60	70,316		4	57
Metal mines and mills	453	868,160	1	14	17
Coke ovens and smelters	3,614	9,300,330	1	74	8
Total	6,084	14,105,504	2	216	15
1961: [3]					
Sand and gravel	1,003	2,028,759		22	11
Quarries and mills	845	1,453,258		65	45
Nonmetal mines [2]	59	64,733			
Metal mines and mills	421	755,019		11	15
Coke ovens and smelters	3,111	8,079,212	1	59	7
Total	5,439	12,380,981	1	157	13

[1] Excludes officeworkers.
[2] Includes clay, greensand marl, and magnesium compounds.
[3] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Output of both fire and miscellaneous clay was 1 percent below the 1960 production. Miscellaneous clay supplied most of the tonnage, but fire clay had a greater value. Miscellaneous clay recovered chiefly in Middlesex and Somerset Counties was used primarily for manufacturing building brick, lightweight aggregate, and heavy clay products. Most of the fire clay, produced in Middlesex, Cumberland, and Camden Counties, was used for firebrick and block and in foundries and steelworks. Moderate quantities of fire clay were used in mortar, linoleum and oil cloth, kiln furniture, heavy clay products, and architectural terra cotta. In addition, some fire clay was used for rotary drilling mud, artificial abrasive, insecticide filler, and for manufacturing pottery and stoneware. Clay was recovered from 24 pits compared with 23 pits in 1960. Of the nine clay-producing counties, Middlesex and Somerset Counties led and ranked second, respectively, in output.

Gem Stones.—Various mineral specimens were obtained from trap-rock quarries throughout the State, from old mine dumps at Franklin (Sussex County), and from other places.

Gypsum.—Calcined gypsum was produced at plants in Bergen and Burlington Counties from crude material shipped from out-of-State mines. The calcined gypsum was used for manufacturing plaster, lath, sheathing, wallboard, and other building materials. Flintkote Co. completed plans for constructing a 165,000-ton-per-year gypsum-processing plant near Camden. Crude gypsum was to be shipped from Newfoundland where large deposits were being developed by the company.

Lime.—Tonnage and value of lime was slightly higher than in 1960. Hydrated lime was produced by one company in Sussex County for use in construction, agriculture, and chemical applications.

Magnesium Compounds.—The quantity of refractory magnesia produced increased slightly, but value was below that of 1960. The refractory magnesia was produced from seawater and out-of-State dolomite in Cape May County. One plant in Warren County refined magnesium compounds from purchased magnesium carbonate.

Marl, Greensand.—Tonnage and value of greensand marl decreased compared with 1960. Output was reported by two producers—one each in Burlington and Gloucester Counties. The greensand was used as a fertilizer and for water softening.

Perlite.—Sales of expanded perlite totaled 10,000 tons valued at $626,000 compared with 9,000 tons valued at $547,000 in 1960. Plants in Middlesex, Passaic, Somerset, and Union Counties expanded crude perlite mined in Southwestern United States. The expanded material was used in acoustical plaster, ultra-lightweight concrete, soil conditioning, and as loose-fill and pipe-covering insulation.

Pigments.—Various metal-base pigments were produced at nine plants. Iron oxide pigments were manufactured in Essex, Mercer, and Middlesex Counties; lead pigment in Middlesex County; and zinc pigment, in Middlesex and Bergen Counties. Titanium dioxide was produced at one plant each in Camden and Middlesex Counties.

Sand and Gravel.—Production of sand and gravel was reported in 14 of the 21 counties. Output increased 6 percent in quantity and 7 percent in value compared with 1960. Greater activity in highway-construction and increased demand from the building industry were prime factors. Consumption of building, paving, fill, and other sand and gravel by the construction industry accounted for 80 percent of the tonnage. In contrast with consumption in the building and construction industry, consumption of sands for industrial uses followed a downward trend.

Although the tonnage of industrial sands was lower, molding, glass, and blast sands, the most important industrially, increased in value. The combined average price for these categories rose from $3.37 per ton in 1960 to $3.51 per ton. Other industrial sands produced were fire or furnace, engine, and filtration sands. Production of ground sand declined; output was used principally by foundries, as a filler, and by the glass industry. Other uses for ground sand included abrasive, chemical, pottery, porcelain, tile, and metallurgical applications. Ninety-one percent of the commercial tonnage was processed material compared with 89 percent in 1960. Over 9 million tons of sand and gravel was shipped to consumers by truck; 1.8 million tons, by rail; and 1.2 million tons, by water. Major producing counties were Morris, Cumberland, Burlington, and Ocean, all producing in excess of 1 million tons. Gravel was produced by Government-and-contractor operations in Atlantic, Camden, and Warren Counties.

Stone.—Value of stone increased for the third successive year to a new record and made up 41 percent of the total value of New Jersey's mineral production. Almost 10 million tons of crushed stone was used in highway and building construction.

TABLE 3.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	3,763	$3,694	3,961	$4,875
Paving	2,116	1,812	2,160	1,792
Fill	134	68	293	112
Molding	1,546	4,731	1,291	4,147
Blast	131	546	138	620
Fire or furnace	14	35	17	38
Engine	21	67	27	80
Filtration	33	114	28	95
Other [1]	933	4,092	935	4,102
Gravel:				
Structural	1,775	3,016	2,133	3,554
Paving	866	1,093	994	1,249
Fill	133	79	189	87
Other [2]	73	146	80	139
Total	11,538	19,493	12,246	20,890
Government-and-contractor operations:				
Sand:				
Paving	2	(3)		
Fill	(4)	(5)		
Gravel:				
Paving	54	18	11	5
Total	56	18	11	5
Grand total	11,594	19,511	12,257	20,895

[1] Includes glass, ground, and other sand.
[2] Includes railroad ballast (1960), other, and miscellaneous gravel.
[3] Less than $1,000. [4] Less than 1,000 tons. [5] Less than $500.

Basalt (traprock), which represented most of the total stone tonnage and value, was produced in six counties. Somerset and Passaic Counties continued to lead in output. Bergen County was third in basalt production because of the large quantities consumed in constructing the new western approaches to the George Washington Bridge. A 2-mile conveyor-belt was installed by a contractor to move crushed traprock to a swampy area requiring an exceptionally large quantity of fill. Traprock also was consumed for riprap, railroad ballast, and other uses.

Limestone, produced in Essex County, continued to rank second in value. Principal uses were as a filler, agstone, additive in livestock food, concrete aggregate, and limekiln feed. Granite, quarried in Morris and Hunterdon Counties, was used mainly for concrete aggregate and roadstone; small quantities were sold for riprap, railroad ballast, and stone sand. Oystershell recovered in Gloucester County was ground for poultry grit and for making lime. Marble mined in Warren County was crushed for use in terrazzo. Miscellaneous stone was quarried in Hunterdon County for dimension stone and in Passaic County for concrete aggregate and roadstone.

Roofing Granules.—Value of roofing granules produced increased 8 percent to $3.4 million; quantity increased 3 percent to 209,000 tons. Average price per ton was $0.22 higher for natural (uncolored) granules and $0.11 higher for those artifically colored. The most common raw material for roofing granules was basalt or diabase (traprock), but some granules were prepared from anorthosite (aplite) mined in Virginia. Minnesota Mining & Manufacturing Co. started producing artifically colored granules in its new plant in Somerset County. The raw material was diabase from the company quarry on Sourland Mountain.

Sulfur.—Shipments of sulfur recovered as a byproduct in the liquid purification of gas, totaled 46,000 long tons valued at $1,023,000. This represented a tonnage increase of 7 percent but a 5-percent decrease in value. Four plants, two in Gloucester County and one each in Middlesex and Union Counties, reported production. Part of the sulfur was captive tonnage used for various chemical processes, and the remainder was sold for manufacturing sulfuric acid.

Vermiculite.—Vermiculite was exfoliated at plants in Essex and Mercer Counties from crude material imported from foreign countries and shipped from other States.

METALS

Federated Metals Division of American Smelting and Refining Company operated three metallurgical plants. The company fabricated lead and indium and produced magnesium and other alloys, babbits, solders, and copper products at Newark and zinc dust at Trenton. Various copper alloys and fabricated lead products were produced at Perth Amboy. The parent company, American Smelting and Refining Company, operated a research laboratory at South Plainfield and produced antimony oxide, bronze, platinum and palladium sponge, refined and high purity bismuth, and refined copper, indium, nickel salts, and silver at Perth Amboy. High-purity beryllium oxide was processed as a ceramic material for special uses in Passaic County. High-purity tungsten and molybdenum metal powders were produced at Springfield in Union County. Platinum-group metals were refined, and alloys were prepared in Newark, Essex County. Rare-earth elements were processed in Essex and Morris Counties to produce high-purity separated metals, alloys, misch metal, ferrocerium, and other compounds. Research on rare-earth elements to develop new uses and improved processing methods was continued.

Ferroalloys.—Ferroalloys were prepared for use at plants in Middlesex, Gloucester, Morris, and Bergen Counties. Shipments included ferroalloys of titanium, molybdenum, vanadium, columbium, columbium-tantalum, and rare earths.

Iron Ore.—Quantity and value of usable iron ore shipped were 8 percent and 5 percent lower, respectively, than in 1960. Crude magnetite ore produced at two mines, one in Morris County and one in Warren County, was beneficiated magnetically. The concentrate was shipped mostly to Conshohocken, Pa., for steelmaking, but part was ground to iron powder and sold for use in powder metallurgy.

Iron and Steel.—Open-hearth steel was produced in Burlington County by John A. Roebling's Sons Division of Colorado Fuel & Iron Corp. Crucible Steel Co. of America continued to produce steel in electric furnaces at its mill in Essex County.

Titanium.—The Glidden Co. completed exploration of its heavy-mineral-bearing sand deposit at the Lakehurst mine in Ocean County. Erection of a building to house offices and the analytical laboratory was completed, and construction of the concentrating plant was started. The company planned to ship ilmenite concentrate to its Pigments Division at Baltimore, Md., for conversion to titanium dioxide.

Uranium.—A small shipment of uranium ore was made in 1960, but no production was reported from the Sussex County deposit of Bemco, Inc., in 1961. The ore in 1960 was shipped to Salt Lake City, Utah, for processing.

Zinc.—The Sterling mine in Sussex County was re-opened and concentrate was shipped to the Palmerton, Pa., smelter during December. Production at the Sterling mine had been discontinued in 1958. The concentrating plant was modernized, and the mine openings were maintained in a standby condition during the shutdown.

MINERAL FUELS

Coke and Coal Chemicals.—A merchant plant that had an annual capacity of 600,000 tons of coke was operated by Koppers Co., Inc., in Hudson County. Coal chemicals recovered as byproducts were ammonium sulfate, monoammonium phosphate, crude coal tar, crude light oil, intermediate light oil, and naphthalene.

Peat.—The average value per ton for peat increased 31 percent, and although tonnage produced was 15 percent below 1960, the value of 1961 output was 11 percent higher. Peat, recovered from two bogs in Sussex County and one each in Somerset and Warren Counties, was sold packaged and in bulk.

Petroleum.—Metropolitan New York was served by five refineries in

TABLE 4.—Capacities of petroleum refineries and cracking plants, January 1, 1961
(Barrels per day)

Company	Location	Type of plant [1]	Crude-oil capacity			Cracked-and-reformed-gasoline capacity		
			Operating [3]	Shut down	Building [2]	Operating	Shut-down	Building [2]
	Gloucester County:							
Mobile Oil Co.	Paulsboro	S-C-K-L	87,000			26,400		
Texaco, Inc.	Westville	S-C	73,000			24,500		
	Middlesex County:							
California Oil Co.	Perth Amboy.	S-C-A	100,000	15,500		25,500	200	
Hess Trading & Transport, Inc. [3]	Sewaren	S-C	71,250			4,000		
	Union County:							
Metropolitan Petroleum Corp.	Bayonne	S		20,000				
Humble Oil & Refining Co.	do	S-A	22,500					
Do.	Linden	S-C-A	170,000			53,200		500
Cities Service Oil Co.	do	S-A	15,000					
Total			538,750	35,500		133,600	200	500

[1] Type of plant: A—Asphalt, C—Craking and/or reforming, K—Coking, L—Lube, and S—Skimming.
[2] Represents capacity under construction on January 1, 1961, and will add to existing capacity.
[3] Oil and Gas Journal, vol. 59, No. 14.

Middlesex and Union Counties. Two refineries in Gloucester County produced petroleum products for the Philadelphia area. The seven active plants had daily operating capacity of 538,750 barrels of crude oil and a cracked and reformed gasoline capacity of 133,600 barrels a day. Research continued on a large scale to solve production problems, to develop new processes, and to expand uses for petroleum products. Laboratories were operated by Cities Service Research & Development Co., Cranberry; Esso Research & Engineering Center, Florham Park; Esso Research Center, Linden; and Socony-Mobil Oil Co., Paulsboro.

REVIEW BY COUNTIES

Mineral production was reported for all counties except Hudson and Salem. In decreasing order of value, the leading mineral-producing areas were Somerset, Morris, Cumberland, and Passaic Counties. Value increases were reported for 11 counties; the greatest increase was in Somerset County.

Atlantic.—Production of commercial sand and gravel decreased 3 percent from 1960 and totaled 97,000 tons. Output, chiefly structural sand and gravel and molding sand, was reported from seven operations. Eighty-two percent of the commercial output was shipped by truck and the remainder by railroad. Crews of the Atlantic County Road Department produced paving gravel. A steel fabricating plant was under construction at Pleasantville.

Bergen.—Traprock was recovered near the George Washington bridge, crushed, and transported 2 miles by conveyor belt to fill a 9-acre dredged lake. The stone was produced under contract to the New Jersey State Highway Department for constructing an interstate-highway interchange. Work on the interchange began in September and was expected to be completed near the end of 1962. The Port of New York Authority contract, under which traprock was excavated for use as concrete aggregate, roadstone, and fill, was completed in 1960. The excavation provided access to the lower deck of the George Washington bridge on the New Jersey side.

Production of sand and gravel increased 8 percent in tonnage and 28 percent in value. Mostly prepared sand and gravel used for building and paving, and some sand for fill, were produced at operations near Wyckoff, Mahwah, Ramsey, and Paramus. Tri-County Brick Corp., Carlstadt, mined alluvial clays for use in manufacturing building brick. Crude gypsum was calcined at the Edgewater plant of Barrett Division, Allied Chemical Corp. The calcined gypsum was used in manufacturing gypsum products at the adjacent Shadyside plant. The Flintkote Co., East Rutherford, produced artificially colored roofing granules. Zinc oxide and leaded zinc oxide pigments

TABLE 5.—Value of mineral production in New Jersey by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Atlantic	$202.926	$187.876	Sand and gravel.
Bergen	2.431.090	2.851.835	Stone, sand and gravel, clays.
Burlington	1,222.531	2.123.662	Sand and gravel. greensand marl, clays.
Camden	1,208,620	2,091,686	Sand and gravel, clays.
Cape May	(2)	(2)	Magnesium compounds, sand and gravel, gem stones.
Cumberland	8,321,757	7,925.390	Sand and gravel, clays.
Essex	(2)	(2)	Stone.
Gloucester	540,020	550,738	Sand and gravel, greensand marl, stone.
Hunterdon	(2)	(2)	Stone.
Mercer	(2)	(2)	Do.
Middlesex	2.215.484	2,114,217	Clays, sand and gravel.
Monmouth	856.934	667.982	Sand and gravel.
Morris	10.706.757	10.205.851	Iron ore, sand and gravel, stone, clays.
Ocean	1,420.172	1,459.486	Sand and gravel.
Passaic	5,685,988	5,781,938	Stone, sand and gravel, clays.
Salem	(2)	----------	
Somerset	9,593,389	10.545,215	Stone, clays, peat.
Sussex	3,487,656	3,683,167	Stone, manganiferous residuum, lime, sand and gravel, peat, zinc, gem stones.
Union	(2)	(2)	Stone.
Warren	(2)	(2)	Iron ore, sand and gravel, stone, clays, peat.
Undistributed [3]	8,515,387	9.019.294	
Total	56,409,000	59,208,000	

[1] No production reported in Hudson County.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Includes value of gem stones, and sand and gravel (1961) not assigned to specific counties and values indicated by footnote 2.

were manufactured by Royce Chemical Co., Carlton Hill. Ultrapure indium, germanium, gold, and rare-earth metals were processed and marketed by High-Purity Metals, Inc., Division of Accurate Specialties Co., Inc., Hackensack.

Burlington.—Sand and gravel, used mostly for building and paving purposes, was recovered at eight operations—three near Burlington, two each near Riverside and Mount Holly, and one near Riverton. Burlington County ranked third in sand and gravel production. Output totaled 1.9 million tons, an increase of 80 percent compared with 1960. Small quantities of molding sand and fill sand and gravel also were produced. Eighty-six percent of the output was processed material, which was shipped mostly by water. National Soil Conservation, Inc., Medford, produced greensand marl for use as a natural fertilizer and soil conditioner. Clay used for manufacturing building brick was recovered near Fieldsboro by Church Brick Co.

National Gypsum Co. calcined crude gypsum for manufacturing finished building materials at its Burlington plant.

Camden.—Commercial sand and gravel was produced near Berlin, Gibbsboro, Grenloch, Gloucester and Pennsauken Townships, and Mount Ephraim. Output totaled 672,000 tons, 13 percent less than in 1960. Production consisted chiefly of molding and other industrial sands and structural and paving materials. Eighty-three percent of commercial production was prepared material. Construction and maintenance crews of the Camden County Highway Department produced paving gravel. New Jersey Division of Alliance Clay Product Co. produced miscellaneous clay near Winslow Junction for manufacturing building brick. Plastic fire clay and miscellaneous clay for refractories were recovered at Delair by Ward Sand & Materials Co. Titanium dioxide pigment was made from ilmenite concentrate at the Gloucester City plant of New Jersey Zinc Co.

Cape May.—Refractory magnesia was produced from purchased dolomite and seawater at the Cape May plant of Northwest Magnesite Co. Building and paving sand and gravel was recovered near Ocean View, Tuckahoe, and Cape May Court House. The output was mostly processed material and was shipped entirely by truck. Iron castings were made at Tuckahoe by Tuck Iron Foundry, a new industry in the county.

Cumberland.—Cumberland County ranked second in tonnage and led in value as a sand- and gravel-producing area and supplied 37 percent of the total sand and gravel valuation in the State. Output totaled 2.3 million tons, a 7-percent decrease compared with 1960. Fifty-six percent of the output was processed material. Fifteen operations were active during the year—mostly near Vineland, Millville, and Port Elizabeth. Output was used mostly for manufacturing glass and as molding sand. In addition, blast, engine, furnace, and filter sand, as well as building and paving sand and gravel were produced. Pennsylvania Glass Sand Corp. and National Glass Sand Corp., both near Millville, produced ground sand. Fifty-six percent of the county output was shipped by truck and the rest by rail. Plastic fire clay used as a binder for foundry sand was recovered at Millville by Daniel Goff Co., Inc.

Essex.—Orange Quarry Co., West Orange, and M. L. Kernan Quarry, South Orange, crushed basalt for use as concrete aggregate and roadstone. Part of the output was sold to nearby communities for use in road maintenance and repair. Vermiculite Industrial Corp., Newark, exfoliated vermiculite imported from Africa. The expanded vermiculite was used for loose fill, home and industrial insulation, and as plaster and concrete aggregate.

E. I. du Pont de Nemours & Co., Inc., manufactured iron oxide pigments (hydrated ferric oxide) at Newark. Crucible Steel Co. of America produced steel in arc-melting and induction furnaces at the Spaulding Works, Harrison. Individual rare-earth metals were recovered from ore concentrates by New Process Metals Division of Ronson Metals Corp. The company produced high-purity rare-earth metals as well as misch metal and ferrocerium at its Newark plant. Research was continued to improve quality and promote new uses for the rare-earth products.

Englehard Industries, Inc., Newark, marketed a new platinum-alloy metal for use in thermocouples for high-temperature applications. It also processed gold and platinum group metals and alloys for industrial use. Part of the output was in ultrapure metals for special applications.

Gloucester.—Sand and gravel production totaled 408,000 tons and was recovered near Mount Ephraim, Bridgeport, Mount Royal, and

Gibbstown. Output, used principally for building and paving, consisted mostly of prepared material.

A small quantity of bank-run furnace sand was recovered near Downer. Greensand marl was mined from a pit near Sewell by Inversand Co.; the glauconite (natural zeolite) content of the greensand was used to soften water for domestic and industrial use. Joseph Bauder & Sons, Franklinville, recovered oystershell for use as poultry grit and for making lime. Byproduct sulfur was recovered in the liquid purification of gas by the modified Baehr process at the Eagle Point (Westville) plant of Freeport Sulphur Co. Mobil Oil Co. also recovered byproduct sulfur at its Paulsboro refinery. Ferroalloys of titanium, vanadium, columbium, columbium-tantalum, and other metals were prepared by Shieldalloy Corp., Newfield.

Hudson.—Coke and coal chemicals were produced at the Kearney plant of Koppers Co., Inc. The company operated 120 slot-type coke ovens and recovered six byproduct chemicals. It did not recover hydrogen sulfide in 1961.

Hunterdon.—Lambertville Quarry Co., Lambertville, and Houdaille Construction Materials, Inc., Oldwick, produced basalt for use chiefly as concrete aggregate and roadstone. Somerset Crushed Stone, Inc., Division of Anthony Ferranti & Sons, quarried and crushed granite at Clinton. Delaware Quarries produced dimension stone (argillite).

Mercer.—Pennington Quarry Co., Pennington, quarried diabase (traprock) for use as riprap, concrete aggregate, roadstone, and railroad ballast. Inmates of the Mercer County Workhouse (Trenton) produced basalt for concrete aggregate and roadstone. Black, brown, red, and yellow iron oxide pigments were manufactured by chemical treatment of scrap iron at Trenton by Columbian Carbon Co. Zonolite Co., Trenton, exfoliated crude vermiculite shipped into the State. A new research center was under construction by National Lead Co. near Hightstown. Research was planned for nonferrous metals, paints, pigments, lead chemicals, plastics, and resins.

Middlesex.—Middlesex County continued to lead among the nine clay-producing counties, supplying 56 percent of the total tonnage. Output of miscellaneous clay and fire clay totaled 366,000 tons, a 16-percent decrease from 1960. The miscellaneous clay was used for manufacturing heavy clay products and lightweight aggregate. The fire clay was used mostly in refractory products. Twelve companies, mainly along the Atlantic Seaboard, reported clay production. Sand and gravel production totaled 799,000 tons, a 3-percent increase over 1960. Eight operations throughout the county were active and produced structural sand and gravel and paving sand. Small quantities of blast, molding, and engine sand, and fill gravel also were produced. Ninety-five percent of the county output was washed, screened, or otherwise prepared.

Coralux Perlite Co. of New Jersey expanded crude perlite, mined in New Mexico, at its Metuchen plant. The expanded perlite was used as aggregate in acoustical plaster and lightweight concrete. Byproduct sulfur was recovered by the modified Claus process of gas purification at the Perth Amboy plant of Anlin Co. Mullite was made from alumina and silica by the Refractories Division of The Carborundum Co. at Perth Amboy. Refractory brick, block, and special shapes made of mullite were sold for use as high-temperature furnace lining in steel mills and glass plants. Red iron oxide pigment (calcined copperas) was manufactured by Columbian Carbon Co. at Monmouth Junction, and by Stabilized Pigments, Inc., at New Brunswick. Titanium dioxide, white lead, red lead, and litharge were manufactured by National Lead Co. at Perth Amboy.

The recently completed South Brunswick plant of Phelps Dodge Copper Products Corp. produced copper, brass, bronze, and cupronickel tubing and pipe. The new, automated aluminum die-casting plant, part of the Edison Works of Aluminum Co. of America, took over aluminum die-casting production formerly done at Garwood, Union County, and Bridgeport, Conn. Metal and Thermit Corp. produced ferrotitanium at its Carteret plant.

Monmouth.—Sand and gravel production totaled 618,000 tons, 30 percent less than in 1960. Output, used chiefly for building and paving, was shipped entirely by truck. Producers were Bennett Sand & Gravel Co., Inc., Manasquan; Benjamin Fary, New Shrewsbury; Hause Gravel Co., Asbury Park; New Jersey Gravel & Sand Co., Farmingdale; Joseph Scarano; Wayside; Frank Z. Sindlinger, Inc., Wall Township; and Walling & Son, Hazlet.

Morris.—A price differential in favor of imported iron ore caused Alan Wood Steel Co. to discontinue development of new blocks of ore at the Scrub Oaks mine. It planned to shut down the mine in 2 or 3 years after hoisting and beneficiating all broken ore in the stopes. Concentrate was shipped to the company steel plant at Conshohocken, Pa. The Mt. Hope mine of Shahmoon Industries, Inc., was idle during 1961, but iron-ore concentrate was shipped from stockpiles of material mined and beneficiated in previous years. Separated rare-earth metals and compounds were prepared from concentrates by Davison Chemical Division of W. R. Grace & Co. at Pompton Plains.

Mine waste and mill tailings from the Scrub Oaks mine were processed and sold for use as concrete aggregate and roadstone by Alan Wood Steel Co. Shahmoon Industries, Inc., Mt. Hope, continued producing crushed and broken granite from a newly developed quarry. Output was sold for concrete aggregate and roadstone, riprap, stone sand, and railroad ballast. Braen Industries, Inc., formerly Samuel Braen's Sons, quarried granite at Riverdale for use as concrete aggregate and roadstone. Morris County led in sand and gravel production, but ranked second in value among the 14 producing counties. Production totaled 2.5 million tons, an increase of 14 percent over 1960. Eight operations were active, producing mainly building and paving material. Most of the output was processed, and shipments were made to consumers mainly by truck. Logansville Pottery, Inc., manufactured flowerpots from clay mined near Bernardsville.

Ocean.—Sand and gravel production, mainly building and paving material, totaled 1 million tons, a 4-percent increase over 1960. Output was recovered at seven operations; most of the material was washed, screened, or otherwise prepared. New Jersey Pulverizing Co. operated a dredge near Bayville, producing molding, blast, engine, and other industrial sand, as well as ground sand for abrasive, filler, and foundry purposes. A concentrating plant for recovering ilmenite from the Lakehurst mine sands in Jackson Township near Ridgeway was under construction by The Glidden Co. The plant, having an annual capacity of 100,000 tons of ilmenite concentrate, was scheduled for completion by mid-1962. The sands will be recovered by dragline and pumped as a slurry from the mine to the concentrating plant.

Passaic.—Passaic County continued to rank second among the stone-producing counties of the State; value increased 4 percent from 1960. Basalt was quarried by Samuel Braen's Sons, Haledon and Hawthorne; Great Notch Corp., Little Falls; Houdaille Construction Materials, Inc., Montclair; Sowerbutt Quarries, Inc., Prospect Park; and Union Building & Construction Corp., Clifton. Most of the basalt was used for concrete and roadstone, but part of the output was used for riprap and roofing granules. Passaic Crushed Stone Co., Inc., quarried gneiss near Pompton Lakes for use as concrete aggregate and roadstone.

Five sand and gravel operations—three near Wayne and one each near Riverdale and Pequannock—produced building and paving material. Production totaled 276,000 tons, a 22-percent decrease over 1960. All the material was washed, screened, or otherwise prepared and then shipped to consumers by truck. Paterson Brick Co., Wayne, manufactured building brick from miscellaneous clay mined nearby. Crude perlite from Nevada was expanded at Paterson by PerAlex of New Jersey, Inc. The processed material was used as ultra-lightweight concrete aggregate and for soil conditioning. H. B. Reed Corp., Passaic, and Great Notch Granule Co., Little Falls, produced natural roofing granules for mineral-surface roofing and siding. National Beryllia Corp. continued to produce high-purity beryllia and alumina shapes. Electronic Mechanics, Inc., built a 500-ton-per-year synthetic mica plant at Clifton. Micro Metals Corp., Passaic, produced chemical-grade iron powder in a range of particle sizes.

Salem.—No mineral production was reported; A. W. Davis Lumber Co., a sand producer, had discontinued operations December 15, 1960.

Somerset.—Somerset County led the stone-producing counties with basalt production of 4.8 million tons valued at $10.3 million. Both tonnage and value were higher than in 1960. The output was sold mostly for concrete aggregate and roadstone but quantities also were used for riprap, railroad ballast, roofing granules, and filler material. Basalt was quarried by Houdaille Construction Materials, Inc., Millington and Bound Brook; Fanwood Stone Crushing & Quarry Co., Watchung; Kingston Trap Rock Co., Kingston; Somerset Crushed Stone, Inc., Bernardsville; and Dockwatch Quarry Pit, Inc., Martinsville. In addition, Minnesota Mining & Manufacturing Co. began producing basalt from a newly developed quarry at Belle Mead. The stone was used locally for manufacturing roofing granules in the company's newly constructed plant.

Miscellaneous clay was produced by New Jersey Shale Brick & Tile Corp. and American Vitrified Products Co., both near Somerville, and Natco Corp. at Middlebush. Output was used for manufacturing building brick, vitrified sewer pipe, and other heavy clay products. Industrial Insulation Division of Johns-Manville Corp., Manville, expanded perlite from crude material shipped from Colorado. The expanded perlite was used in manufacturing pipecovering insulation. Natural and artificially colored roofing granules were produced at the

Bound Brook plant of Central Commercial Co. Mt. Bethel Humus Co. recovered humus peat from a bog near Great Meadows.

Sussex.—Limestone was quarried by Farber White Limestone Co. at Franklin and Limestone Products Corp. of America at Newton and sold for a wide variety of uses. The principal uses were for agstone, concrete aggregate, and roadstone, and as a filler in flooring, rubber, and asphalt. The limestone also was used in manufacturing lime, as an additive in animal feed, poultry grit, filter medium, and roofing granules. Limestone Products Corp. burned limestone at its Lime Crest plant and produced hydrated lime for use in construction, and for agricultural and chemical applications. Sand and gravel, used mostly for building and paving, was recovered near Fairlawn, Andover, and Newton. Output totaled 250,000 tons, 11 percent higher than in 1960. During the year, thousands of amateur gem and mineral collectors visited old mine dumps near Franklin. Various mineral specimens, chiefly fluorescent calcite, franklinite, willemite, and zincite, were collected.

The Sterling mine at Ogdensburg was re-opened, and manganiferous-zinc concentrate was shipped to Palmerton, Pa. for smelting. No uranium ore was shipped during 1961 by Bemco, Inc., from its deposit in the southeastern part of the county. Reed-sedge peat was produced by Hyper-Humus Co., Newton, and Netcong Natural Products, Stanhope, and sold, packaged and in bulk, for use as a soil conditioner.

Union.—Houdaille Construction Materials, Inc., quarried basalt at Summit for concrete aggregate and roadstone. Crude perlite mined in Colorado was expanded by Certified Industrial Products, Inc. (Hillside), for use in building plaster, concrete aggregate, and soil conditioning. Esso Standard Oil Co. recovered hydrogen sulfide by diethanolamine treatment at its Bayway Refinery. The sulfide gas was delivered to the nearby chemical plant of General Chemical Division, Allied Chemical Corp., Elizabeth, where elemental sulfur was recovered and consumed by the company. Hatfield Wire & Cable Division of Continental Copper and Steel Iudustries, Linden, began producing copper and steel rod in its newly installed automated mill to supply the company's wire-drawing division. Metals and Residues, Inc., Springfield, produced high-purity tungsten and molybdenum powders by a single-stage reduction process in newly installed furnaces.

Warren.—Sand and gravel, used chiefly as building and paving material, was produced by Houdaille Construction Materials, Inc., Carpentersville; Van Horn Sand & Gravel Co., Belvidere; and Steckel Concrete Co., Phillipsburg. Most of the output was processed material. Marble used exclusively for terrazzo was quarried and crushed by Royal Green Marble Co. at Phillipsburg. Miscellaneous clay was produced by Natco Corp. at Port Murray and used for manufacturing building brick. A variety of refined mangnesium compounds including chloride, extra-light trisilicate, sulfate, accetate, and phosphate, were produced by J. T. Baker Chemical Co. at Phillipsburg. Magnetite concentrate produced at the Alan Wood Steel Co. Washington mine was used in making steel at the company Conshohocken, Pa., plant. Tamarack Humus Co., Buttzville, recovered and processed humus peat which was sold in bulk for agricultural purposes.

The Mineral Industry of New Mexico

By A. D. Hahn[1]

◆

MINERAL production in New Mexico in 1961 was valued at $688.9 million, an increase of $35.7 million and a gain of 5 percent compared with that of 1960. The value of fuels increased $9.9 million; nonmetals, $18.6 million; and metals, $7.2 million. Pro-

TABLE 1.—Mineral production in New Mexico[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite .... short tons..	492	$10	600	$10
Beryllium concentrate .... short tons, gross weight..	....	....	24	12
Carbon dioxide (natural) .... thousand cubic feet..	230,115	(2)	242,903	(2)
Clays[3] .... thousand short tons..	56	132	67	165
Coal (bituminous) .... do....	295	1,747	412	2,477
Copper (recoverable content of ores, etc.) .... short tons..	67,288	43,199	79,606	47,764
Gem stones	(4)	40	(4)	46
Gold (recoverable content of ores, etc.) .... troy ounces..	5,423	190	6,201	217
Gypsum .... thousand short tons..	55	193	105	386
Helium .... thousand cubic feet..	43,494	684	42,224	762
Iron ore (usable) .... thousand long tons, gross weight..	1	27	(2)	(2)
Lead (recoverable content of ores, etc.) ..... short tons..	1,996	467	2,332	480
Lime .... thousand short tons..	36	496	25	350
Mica (scrap) .... short tons..	235	7	1,800	52
Natural gas .... million cubic feet..	798,928	85,485	789,662	86,073
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons..	321,667	20,412	301,404	18,619
LP gases .... do....	645,116	28,788	656,751	24,154
Perlite .... short tons..	240,593	2,119	245,654	2,159
Petroleum (crude) .... thousand 42-gallon barrels	107,380	305,895	[5] 112,083	[5] 320,784
Potassium salts thousand short tons, K_2O equivalent..	2,440	[6] 82,645	2,523	96,380
Pumice .... thousand short tons..	365	827	339	879
Salt .... do....	39	331	33	284
Sand and gravel .... do....	7,419	7,459	12,523	10,049
Silver (recoverable content of ores, etc.) thousand troy ounces..	304	275	283	261
Stone .... thousand short tons..	1,277	1,692	1,853	2,206
Uranium ore .... short tons..	3,793,494	61,827	3,631,036	62,482
Zinc (recoverable content of ores, etc.) .... do....	13,770	3,553	22,900	5,267
Value of items that cannot be disclosed: Cement, clays (fire clay), magnesium compound, manganiferous ore, mica, (sheet—1960), molybdenum, vanadium, and values indicated by footnote 2	....	5,266	....	7,237
Total New Mexico[7]	....	[6] 653,226	....	688,908

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Excludes fire clay; included with "Value of items that cannot be disclosed."
[4] Weight not recorded.
[5] Preliminary figure.
[6] Revised figure.
[7] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

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[1] Mining engineer, Bureau of Mines, Socorro, N. Mex.

duction was reported from all except 1 (Los Alamos) of the State's 32 counties. Five counties in which the value of the mineral production was more than $40 million, in order of rank, were Lea, Eddy, Grant, McKinley, and San Juan. The five principal mineral commodities produced, in order of value, were petroleum, potassium salts, natural gas, uranium ore, and copper.

The values of output of natural gasoline and liquid petroleum gases in the fuels group; of lime, salt (common), and sheet mica in the nonmetals group; and of vanadium, iron ore, manganiferous ore, and silver in the metals group were lower than that of 1960.

Employment and Injuries.—Final data for 1960 and preliminary data for 1961 compiled by the Bureau of Mines for employment and injuries in the New Mexico mineral industries, excluding the petroleum industry, are shown in table 2.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	Number of operations[2]	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Nonfatal	
1960:						
Nonferrous mines, mills, and smelter	92	1,799	4,414,538	1	137	31.3
Metal mines and mills (other)	5	66	132,577	--------	21	158.4
Uranium mines and mills	68	3,507	8,504,696	15	501	60.7
Potash mines and mills	12	2,580	6,617,779	1	294	44.6
Nonmetal mines and mills (other)	70	426	687,808	--------	12	17.4
Stone quarries and plants	37	177	325,470	--------	7	21.5
Sand and gravel plants	120	499	736,871	--------	17	23.1
Coal mines	26	225	310,502	--------	16	51.5
Total	430	9,279	21,730,241	17	1,005	47.0
1961:[3]						
Nonferrous mines, mills, and smelter	100	1,705	4,118,255	2	189	46.4
Metal mines and mills (other)	6	131	278,848	--------	14	50.2
Uranium mines and mills	58	3,109	7,311,422	4	206	28.7
Potash mines and mills	15	2,624	6,802,624	5	210	31.6
Nonmetal mines and mills (other)	63	272	452,093	--------	18	40.0
Stone quarries and plants	52	220	445,386	--------	1	2.2
Sand and gravel plants	103	1,047	1,508,070	--------	11	7.3
Coal mines	23	239	359,615	1	17	50.1
Total	420	9,347	21,276,313	12	666	31.9

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Preliminary figures.

Legislation and Government Programs.—An Office of Minerals Exploration (OME) contract with Tri-State Metals Corp. for beryl and tantalum exploration in Taos County was terminated by mutual agreement.

An extension of the termination date to December 31, 1966, was made on all contracts for the purchase of uranium oxide from uranium ore processing mills in New Mexico by the Atomic Energy Commission (AEC). The contracts also provided for the purchase of a stipulated maximum quantity of concentrate.

The New Mexico Legislature enacted and Governor Mechem signed into law HB 233, which raised the severance tax on uranium from one-half to 1 percent of the total value of the ore. The potash industry will be required to pay tax on 80 percent of the product value instead of 75 percent in effect prior to mid-1961.

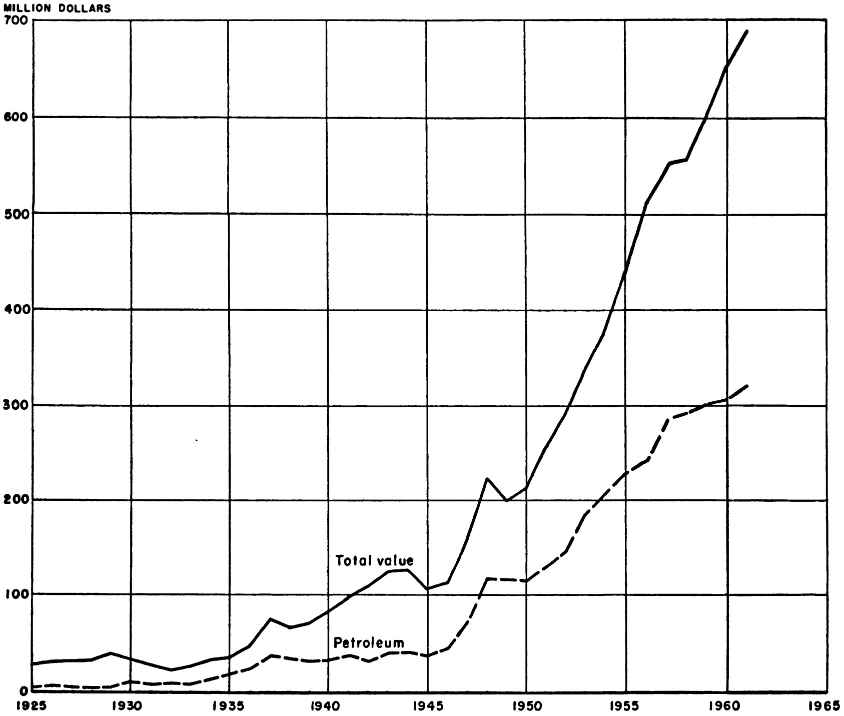

FIGURE 1.—Value of petroleum production and total value of all minerals produced in New Mexico, 1925–61.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of the mineral fuels (carbon dioxide, coal, helium, natural gas, natural gas liquids, and petroleum) was 2 percent greater than in 1960 and represented 66 percent of the total value of all mineral production in the State.

Carbon Black.—Carbon black production declined in 1961. The material was processed in Lea County in plants of Columbian Carbon Co., Continental Carbon Co., and United Carbon Co. The quantity of natural gas used in the production of carbon black was 43.1 billion cubic feet, a decline of 10 percent for the year.

Carbon Dioxide.—Production of carbon dioxide gas from wells in Harding County increased 6 percent in quantity, and the value of the output was higher than in 1960. The gas was processed and marketed as dry ice and liquid carbon dioxide.

Coal (Bituminous).—The tonnage of bituminous coal mined increased 40 percent, and the value of the output increased 42 percent. An increased use of New Mexico coking coal by steel industries in California contributed to this expanded output. The major gain in production was at mines in Colfax County. Construction of a railroad spurline from a point 8 miles west of Gallup, north to The Pittsburg & Midway Coal Mining Co. strip-pit mine site in western McKinley County, was started in 1961. Groundbreaking ceremonies were held March 10 for the Four Corners powerplant of Arizona Public Service Co., southwest of Farmington, on the Navajo Indian Reservation, San Juan County. The coal-burning steam-electric generating plant, with planned initial capacity of 350,000 kw, was to cost approximately $62 million. Fuel was to be subbituminous coal mined by Utah Mining Co. from beds on Navajo tribal lands in New Mexico.

Helium.—The Federal Bureau of Mines helium plant at Shiprock was operated throughout the year. The quantity of helium recovered from natural gas was 3 percent less than in 1960 owing to a decline in the supply of helium-bearing natural gas from the single well that supplied gas for processing.

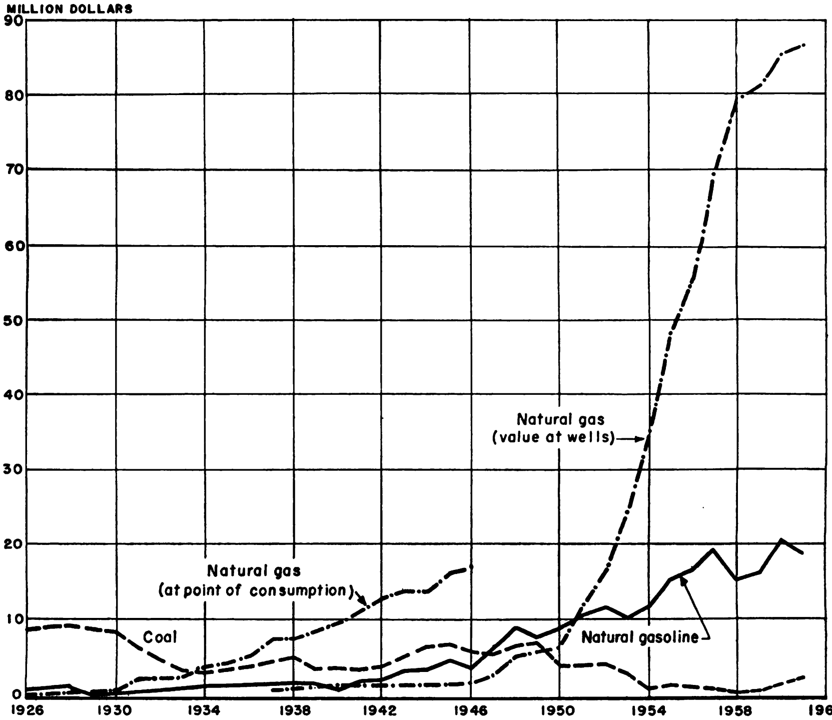

FIGURE 2.—Value of natural gas, natural gasoline, and coal in New Mexico, 1926–61.

Natural Gas.—New Mexico's Oil and Gas Conservation Commission began prorationing of gas produced from the Dakota formation in the San Juan basin in February. Natural gas production from oil wells and dry gas wells declined 3 percent compared with the 1960 output. Production was from 15,293 oil wells and 6,491 gas wells, and the southeastern part of the State produced 54 percent of the total. Dry gas wells contributed 61 percent of the total, and 89 percent of the output was processed at natural gas plants for the recovery of natural gas liquids. Data published by the New Mexico Oil & Gas Engineering Committee[2] showed a total production of 786.6 billion cubic feet of gas—309.3 billion cubic feet from oil wells and 477.3 billion cubic feet from gas wells.

TABLE 3.—Coal (bituminous) production by counties

(Excludes mines producing less than 1,000 short tons)

County	1960		1961	
	Short tons	Average value per ton [1]	Short tons	Average value per ton [1]
Colfax	212,114	$6.10	367,117	$6.04
McKinley	69,584	5.44	35,083	5.73
Rio Arriba	7,398	5.58	4,552	5.96
Sandoval	1,457	6.50	2,314	6.50
San Juan	4,209	5.75	3,075	5.00
Total	294,762	5.93	412,141	6.01

[1] Value received or charged f.o.b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if the coal had been sold commercially.)

Underground gas storage capacity remained unchanged at 77.9 billion cubic feet.[3]

Natural Gas Liquids.—New Mexico ranked fifth in the Nation in production of natural gas liquids. Proved recoverable reserve of natural gas liquids was estimated at 520 million barrels, an increase of 35.2 million barrels for the year.[4] The number of processing plants increased from 26 to 35.[5] Throughput of 665.6 billion cubic feet of gas yielded natural gasoline (7 million barrels), butane (5.8 million barrels), propane (8.1 million barrels), and isobutane and other LP gases (1.7 million barrels). Residual gas was used for plant fuel (41.3 billion cubic feet), for lease fuel (4.8 billion), for the manufacture of carbon black (25.7 billion), and for repressuring (3.2 billion); and it was returned to pipelines (566.8 billion). Continental Oil Co. El Mar Plant No. 26, Lea County, reported production beginning in February. Beginning in October, Nearburg & Ingram reported production from the Bluitt gasoline plant at Milnesand, Roosevelt County; and Pan American Petroleum Corp. reported production from the Empire-Atoka absorption unit near Artesia, Eddy County. The Cabot Corp. King plant, Lea County, was absorbed into Sinclair Plant No. 29, in August.

Petroleum.—Petroleum was recovered in eight counties, Chaves, Eddy, Lea, and Roosevelt in the southeastern part, and McKinley, Rio Arriba, San Juan, and Sandoval in the northwestern part.[6] The southeastern part of the State was the most productive area, having an output of 95.6 million barrels from 13,627 oil wells and 1.2 million

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[2] New Mexico Oil & Gas Engineering Committee. Annual Report. V. 1–2, 1961, 518 pp.
[3] Oil and Gas Journal. V. 60, No. 15, Apr. 9, 1962, p. 79.
[4] Oil and Gas Journal. V. 60, No. 5, Jan. 29, 1962, p. 127.
[5] Oil and Gas Journal. V. 60, No. 18, Apr. 30, 1962, p. 90.
[6] Work cited in footnote 2.

TABLE 4.—Crude petroleum production, by counties

(Thousand barrels)

County	1960	1961	Principal fields (those producing more than 1 million barrels) in 1961, in order of production
Chaves	3,633	4,519	Caprock.
Eddy	11,323	14,114	Empire Abo, Grayburg Jackson, Loco Hills, Artesia Queen.
Lea	75,006	74,093	Denton, Gladiola, Hobbs, Vacuum, Maljamar, Langlie, Saunders, Eumont, Caprock East, Eunice, Jalmat, Kemnitz, Crossroads, Drinkard, Lovington, Pearl Queen.
McKinley	114	129	
Rio Arriba	872	1,276	
Roosevelt	1,188	3,864	Allison.
Sandoval	14	23	
San Juan	12,431	14,307	Horseshoe, Bisti, Cha Cha, Totah.
Total	104,581	112,325	

Source: New Mexico Oil & Gas Engineering Committee. Annual Report. V. 1-2, 1961, 518 pp.

TABLE 5.—Wildcat- and development-well completions in 1961, by districts and counties

District and county	Crude	Condensate	Gas	Dry	Service	Total	Footage
West New Mexico:							
Wildcat:							
McKinley	1			9		10	5,900
Moro				1		1	1,800
Rio Arriba	5		2	15		22	95,400
Sandoval				10		10	33,400
San Juan	8	1	1	41		51	158,400
Total	14	1	3	76		94	294,900
Development:							
McKinley	1				3	4	1,500
Rio Arriba	36	1	125	14		176	910,300
Sandoval	2		3	9		14	29,100
San Juan	174		275	48		497	2,593,800
Total	213	1	403	71	3	691	3,534,700
East New Mexico:							
Wildcat:							
Chaves	3			13		16	65,900
Curry				1		1	8,200
Eddy	12	1	4	42		59	276,900
Harding				1		1	1,700
Lea	28	1	2	72		103	788,300
Otero				4		4	13,200
Roosevelt	1			5		6	57,200
Union				3		3	11,800
Valencia				1		1	4,600
Total	44	2	6	142		194	1,227,800
Development:							
Chaves	22			7	5	34	98,100
Eddy	244		7	82	1	334	1,136,400
Lea	316		16	69	5	406	2,457,400
Roosevelt	52	1		10		63	607,300
Total	634	1	23	168	11	837	4,299,200
Total all drilling	905	5	435	457	14	1,816	9,356,600

Source: Oil and Gas Journal.

barrels of distillate from 1,316 gas wells. Production in the northwestern part was 14.2 million barrels from 1,666 oil wells and 1.5 million barrels of distillate from 5,175 gas wells.[7] In output New Mexico ranked seventh among oil-producing States.[8] The increase in petroleum production in 1961, compared with that of 1960, came from new oil; average allowables for both years were approximately the same.

Exploratory and development drilling, 9.4 million feet, was 1.4 percent more than in 1960. The number of wells drilled total 1,816, a decline of 34 for the year.[9]

The proved crude oil reserve increased 6 million barrels. Two new oilfields, Cha Cha and Totah, were opened in northwestern New Mexico; they lie side by side in San Juan County.[10]

Five refineries were operated in 1961. The El Paso Natural Gas Products Co. plants at Bloomfield, Brickland, and Prewitt were shut down.[11]

NONMETALS

Barite.—Galbar, Inc., recovered barite and galena concentrate from selected mill tailing at the Mex-Tex mill at San Antonio in Socorro County. The barite was processed and ground for use in oil-well drilling mud. Barite ore was not mined in New Mexico in 1961.

Cement.—Portland and masonry cements were manufactured at the Ideal Cement Co. Tijeras plant east of Albuquerque. Additions to the plant machinery and equipment were completed in December 1960, and the plant operated continuously throughout 1961.

Clays.—The tonnage of miscellaneous clay or shale sold or used was 20 percent more than in 1960. Principal uses were in the manufacture of cement, brick, sewer tile, and drain tile. Production was from Bernalillo, Dona Ana, and McKinley Counties. Fire clay was produced in Hidalgo, Luna, and McKinley Counties.

Fluorspar.—Fluorspar mining was dormant in New Mexico in 1961.

Gem Stones.—The value of gem stones and mineral specimens produced in New Mexico was 15 percent more than in 1960. Agate headed the list of stones sold, but included as minerals desired by the buying public were petrified wood, Mexican onyx, amethyst, quartz crystal, jasper, chalcedony, aragonite, turquoise, and smithsonite. The principal source of gem stones was in Luna County, and the value of that county's output constituted about one-third of the total for New Mexico in 1961.

Gypsum.—The tonnage of gypsum mined was about double that of 1960. A significant factor in the increased output was the use of gypsum in the manufacture of wallboard at the American Gypsum Co. Albuquerque wallboard plant, which was completed late in 1960. Gypsum also was used at the Kaiser Gypsum Co., Inc., Rosario plant and the Ideal Cement Co. Tijeras plant.

Lime.—The tonnage of lime produced and used by Kennecott Copper Corp.. Grant County, the only producer, was less than in 1960.

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[7] Work cited in footnote 2

[8] Page 126 of work cited in footnote 4.

[9] Pages 160 and 182 of work cited in footnote 4.

[10] Page 111 of work cited in footnote 4.

[11] Oil and Gas Journal. V. 60, No. 12, Mar. 19, 1962, pp. 135, 170.

Magnesium Compounds.—The Carlsbad plant of International Minerals & Chemical Corp. (IMC) was the only plant producing magnesium compounds in New Mexico. These compounds were used by the electrical, fertilizer, uranium, and chemical industries.

Mica.—Production of scrap mica increased nearly sevenfold compared with that of 1960. Construction of the Clute Corp. grinding mill at Pojoaque was completed in December 1960; its operation accounted for most of the expanded output of scrap mica. The Los Compadres Mica Co. grinding mill at Ojo Caliente operated throughout the year and purchased scrap mica and mica-bearing dump rock from various individuals and producers in northern New Mexico. More than two-thirds of the mica-bearing feed processed by the grinding mills was micaceous schist mined from open pits.

Sheet mica was not produced in 1961.

TABLE 6.—Mica sold or used by producers

	1957	1958	1959	1960	1961
Hand-cobbed mica,[1] total: Pounds	52,150	97,780	14,828	81	----------
Sheet mica:[1]					
Full-trimmed:					
Pounds	----------	176	59	----------	----------
Value	----------	$2,654	$676	----------	----------
Average per pound	----------	$15.08	$11.46	----------	----------
From hand-cobbed mica:					
Pounds	2,134	1,615	188	5	----------
Value	$15,645	$15,743	$922	$4	----------
Average per pound	$7.33	$9.75	$4.90	$0.80	----------
Total:					
Pounds	2,134	1,791	247	5	----------
Value	$15,645	$18,397	$1,598	$4	----------
Average per pound	$7.33	$10.27	$6.47	$0.80	----------
crap mica:					
Short tons	1,347	787	210	235	1,800
Value	$46,865	$24,466	$6,562	$6.780	$52,200
Average per ton	$34.79	$31.09	$31.25	$28.85	$29.00
Total sheet and scrap mica:					
Short tons	1,348	788	210	235	1.800
Value	$62,510	$42,863	$8,160	$6,784	$52,200

[1] Sold to the Government through GSA.

Perlite.—New Mexico continued as the leading producer of perlite in the United States in 1961. The major part of the output was quarried in The Seven Hills of Taos area in northwest Taos County and shipped from the railhead at Antonito, Colo., about 20 miles north of the deposits. Operators were Great Lakes Carbon Corp., Johns-Manville Products Corp., and United Perlite Corp. Expansions of the Great Lakes Carbon Corp. quarrying facilities at No Agua and the product preparation plant at Antonito were completed. Part of the expanded facilities was equipment transferred from former operations in Socorro County, where mining and processing of perlite terminated in the spring of 1961. United States Gypsum Co. continued to mine and mill perlite at Grants.

Potash.—Mine production of potassium-bearing ores (sylvinite and langbeinite) increased to 15.7 million tons and contained 2.9 million tons of recoverable equivalent (92 to 98 percent K_2O). Total stocks of potash products held by producers increased 87 percent, to 857,354 tons, by yearend. Expanded and improved milling facilities, estimated to cost $3.5 million, were being constructed by Potash Company of America. Completion of the expansion program was scheduled for mid-1962. IMC completed underground and surface improvements costing $1.8 million. Included was a $300,000 Goodman potash borer with two 6-foot revolving heads, $200,000 worth of auxiliary mining equipment, and a 10,000-ton raw-ore storage building costing $600,000. Completion of a new shaft and auxiliary installations, at an estimated cost of $2 million, permitted production at the new ore body of Duval Sulphur & Potash Co., 13 miles northwest of the company processing plant, in mid-1961.

TABLE 7.—Crude perlite sold or used by producers

Year	Short tons	Value (thousands)
1957	187,259	$1,568
1958	202,046	1,790
1959	240,642	2,121
1960	240,593	2,119
1961	245,654	2,159

TABLE 8.—Potassium salts production and sales

(Thousand short tons)

Year	Crude salts,[1] mine production		Marketable potassium salts					
			Production			Sales		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value[2] (thousands)	Gross weight	K_2O equivalent	Value (thousands)
1957	12,893	2,430	3,528	2,080	$77,197	3,353	1,977	$73,243
1958	12,224	2,309	3,355	1,978	69,106	3,650	2,157	75,343
1959	13,933	2,588	3,707	2,189	74,117	3,821	2,258	76,725
1960	15,071	2,841	4,138	2,440	[3] 82,645	4,092	2,412	[3] 81,653
1961	15,653	2,934	4,281	2,523	96,380	3,882	2,281	87,415

[1] Sylvite and langbeinite.
[2] Derived from reported value of "Sold or used."
[3] Revised figure.

A new firm, Kermac Potash Co., was formed to mine and mill potash beds 30 miles northeast of Carlsbad. The firm, owned jointly by Kerr-McGee Oil Industries, Inc., and National Farmers Union Service Corp., controlled 15,099 acres of Federal leases and 6,331 acres of State leases in the Carlsbad potash basin. An estimated 80 million tons of ore with an average grade of 18.43 percent K_2O had been blocked out.[12]

Pumice.—The tonnage of crude and processed scoria, volcanic cinders, and pumice produced declined 7 percent, compared with 1960; but the value of the products increased 6 percent. Scoria and volcanic cinders constituted 79 percent of the total tonnage but only 55 percent of the value of the products. The principal uses of scoria and volcanic cinders were as aggregate in the manufacture of concrete block, as roofing, and as railroad ballast. A minor use of lava stone was as a building and decorative stone. Pumice was sold for use as a lightweight concrete aggregate, for use as poured insulating material in walls, as a water filtration medium, and in the manufacture of matches and paint.

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[12] Skillings' Mining Review. New Company to Mine Potash. V. 50, No. 48, Dec. 2, 1961, p. 20.

Salt.—Output of salt declined 15 percent in tonnage, and 14 percent in value, compared with 1960. A large part of the production in 1961 was recovered as a byproduct of potash refining at plants near Carlsbad. Salt was obtained by solar evaporation of brine at Salt Lake, north of Quemado. Markets for the product included stock ranchers, feed dealers, water-softener sales and service establishments, and State and county highway departments.

Sand and Gravel.—Sand and gravel production increased 69 percent in quantity and 35 percent in value over that of 1960. Production was reported in all counties except Curry, Harding, Los Alamos, and Mora. San Juan County was the leading producing area; output of 5.4 million tons was 43 percent of the State total and more than 13 times the tonnage reported in 1960. Counties in which production more than doubled in 1961 were Catron, Colfax, Grant, Hidalgo, Quay, San Juan, Sierra, Socorro, Taos, Union, and Valencia. Production declined in eight counties; namely, De Baca, Eddy, Lincoln, Luna, McKinley, San Miguel, Santa Fe, and Torrance. A total of 99 operations was active. Of these, 59 were commercial operations producing one-third of the output, and 40 were Government-and-contractor operations.

A U.S. Department of Commerce report[13] stated that of a total of 1,005.2 miles designated as a part of the Interstate Highways System in New Mexico, 297.7 miles was open to traffic. Of this 297.7 miles, 211.1 miles was completed to full and acceptable standards, and 86.6 miles was improved to standards adequate for present traffic.

TABLE 9.—Sand and gravel production in 1961, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Bernalillo	1,422	$1,437	Quay	572	$749
Catron	58	154	Rio Arriba	697	901
Chaves	803	850	Roosevelt	(1)	(1)
Colfax	168	173	Sandoval	63	84
De Baca	(1)	(1)	San Juan	5,388	1,452
Dona Ana	439	337	San Miguel	13	22
Eddy	135	131	Santa Fe	397	521
Grant	236	343	Sierra	59	83
Guadalupe	65	153	Socorro	130	198
Hidalgo	177	181	Taos	357	389
Lea	84	91	Torrance	62	75
Lincoln	1	1	Union	54	140
Luna	42	45	Valencia	318	542
McKinley	202	435	Other counties	262	284
Otero	319	278			
			Total	12,523	10,049

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other counties."

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[13] Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1961. Press release BPR 62-4, Feb. 7, 1962.

Work in progress on December 31 included 41.3 miles under construction and 186.9 miles in the engineering and right-of-way planning stage.

TABLE 10.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Construction sand:				
Building	929	$1,043	796	$927
Paving	103	102	153	211
Fill	(1)	(1)	34	55
Other	89	57	95	136
Total sand	1,121	1,202	1,078	1,329
Construction gravel:				
Building	986	1,378	792	1,033
Paving	3,084	2,645	1,919	2,170
Railroad ballast	----------	----------	46	25
Fill	55	48	92	167
Other	(2)	(3)	4	8
Miscellaneous gravel	110	75	180	180
Total gravel	4,235	4,146	3,033	3,583
Total sand and gravel	5,356	5,348	4,111	4,912
Government-and-contractor operations:				
Sand:				
Building	22	31	26	24
Paving	15	14	167	183
Total sand	37	45	193	207
Gravel:				
Building	39	77	23	63
Paving	1,987	1,989	3,066	3,895
Fill	----------	----------	5,130	972
Total gravel	2,026	2,066	8,219	4,930
Total sand and gravel	2,063	2,111	8,412	5,137
All operations:				
Sand	1,158	1,247	1,271	1,536
Gravel	6,261	6,212	11,252	8,513
Grand total	7,419	7,459	12,523	10,049

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Less than 500 short tons.
[3] Less than $500.

TABLE 11.—Stone production in 1961, by counties

County	Short tons	Value	County	Short tons	Value
Bernalillo	(1)	(1)	Otero	27,318	$27,318
Chaves	43,200	$64,550	Rio Arriba	(1)	(1)
Colfax	111,175	59,400	Roosevelt	31,428	58,192
Curry	55,420	78,696	San Juan	125	250
Eddy	469,135	530,757	San Miguel	89	1,341
Grant	68,127	63,606	Sierra	5,600	19,166
Harding	45,250	30,600	Union	202,525	136,464
Lea	35,520	51,266	Valencia	80	11,029
Lincoln	172,149	375,093	Other counties	511,987	615,855
Luna	81	1,782			
Mora	73,900	80,301	Total	1,853,109	2,205,666

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other counties."

Stone.—The tonnage and value of stone production increased 45 and 30 percent, respectivel, compared with 1960. Major tonnage increases were recorded in the production of crushed limestone and crushed sandstone. A decline was noted in the tonnage of basalt quarried. The major producing counties were Eddy and Bernalillo. Counties in which more than 100,000 tons was produced, in order of rank, were Eddy, Bernalillo, Union, Lincoln, and Colfax.

TABLE 12.—Stone sold or used by producers, by kinds

Year	Granite		Basalt and related rocks (traprock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1957	----------	----------	9,300	$6,100	----------	----------	715,900	$1,147,400
1958	26,100	$24,500	9,075	9,000	200	$2,500	795.077	801,487
1959	----------	----------	1,000	5,200	37	732	224,501	298,648
1960	1,869	2,492	9,418	21,750	----------	----------	696,268	927,717
1961	----------	----------	2,025	2,025	80	11,029	1,164,575	1,516,250

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1957	615,060	$456,845	8,100	$7,200	1,348,360	$1,617.545
1958	900,033	669,790	----------	----------	1,730,485	1,507.277
1959	175,315	179,996	60,362	57,376	461,215	541,952
1960	64	1,105	569,001	739,312	1,276,620	1,692,376
1961	115,331	87,587	571,098	588,775	1,853,109	2,205,666

Sulfur.—Sulfur was recovered from natural gas at extraction plants in southeastern New Mexico.

METALS

Beryllium.—Beryl-bearing pegmatite rock was mined and beryl crystals were hand sorted from the broken rock by a small crew at the Harding mine in Taos County. Beryl shipments in 1961 included hand-cobbed crystals that had been sorted and stockpiled at the mine in 1960.

Copper.—Copper production increased 18 percent in quantity and 11 percent in value compared with that of 1960. Although copper was produced and sold from 55 mining and precipitating operations in 12 counties, more than 98 percent of the State output was produced at three mines; namely, Chino and Bayard (Continental) in Grant County, and Bonney-Miser's Chest in Hidalgo County.

Gold.—Gold was recovered from materials treated from 20 lode mines and 1 placer operation. Output was 6,201 ounces, an increase of 778 ounces over that of 1960. Mines in Grant and Hidalgo Counties produced 97 percent of total output; the Kennecott Copper Corp. Chino mine, the Banner Mining Co. Bonney-Miser's Chest mine, and the Brannan & Fuller Atwood-Henry Clay mines were the leading producers.

Iron Ore.—A small tonnage of magnetite was produced at the Hanover-Bessemer mine in Grant County and shipped for use in the manufacture of high-density concrete.

TABLE 13.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1952-56 (average)	57	3	8,031	2,859	$100	288	260
1957	60	------------	8,060	3,212	112	309	280
1958	20	------------	5,873	3,378	118	159	144
1959	30	------------	4,686	3,155	110	159	144
1960	33	------------	7,804	5,423	190	304	275
1961	39	1	7,751	6,201	217	283	261
1848-1961	------------	------------	(3)	2,235,680	51,583	72,623	57,351

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	69,982	$45,382	4,038	$1,231	22,928	$6,670	$53,643
1957	67,472	40,618	5,294	1,514	32,680	7,582	50,106
1958	55.540	29,214	1,117	261	9,034	1,843	31,580
1959	39,688	24,369	829	191	4,636	1,066	25,880
1960	67,288	43,199	1,996	467	13,770	3,553	47,684
1961	79,606	47,764	2,332	480	22,900	5,267	53,984
1948-1961	2,339,840	953,208	335,282	46,815	1,232,234	232,524	1,341,481

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, old slag, or copper precipitates shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed or tonnage of precipitates shipped.

[3] Data not available.

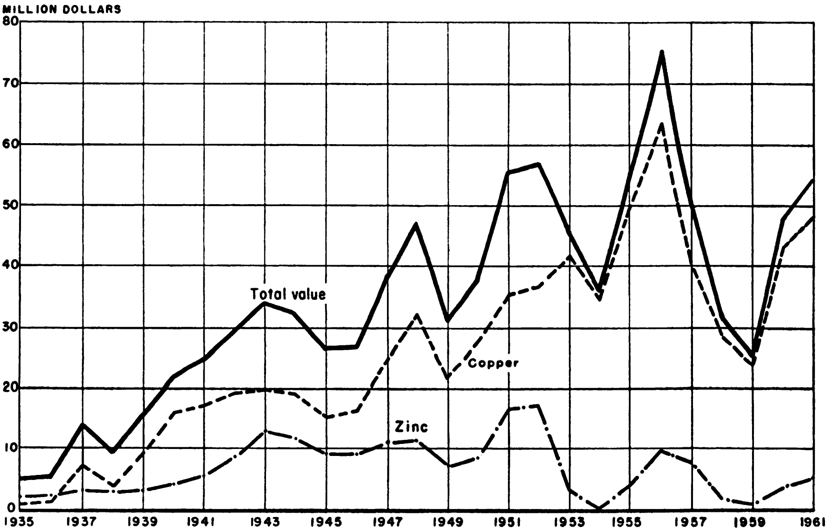

FIGURE 3.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1935–61. The value of gold, silver, and lead produced annually has been relatively small.

TABLE 14.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing (lode) [1] [2]	Lode material sold or treated [3] (short tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
Dona Ana	1	---	---	---	---	---
Grant	9	7,577,749	3,065	$107,275	122,213	$112,985
Hidalgo	8	137,362	2,969	103,915	112,097	103,633
Lincoln	1	250	2	70	275	254
Luna	1	49	---	---	73	67
Otero	2	1,993	---	---	190	176
Rio Arriba	1	4	---	---	---	---
Sandoval	2	99	---	---	23	21
Santa Fe	[4] 3	242	[5] 47	[5] 1,645	[5] 466	[5] 431
Sierra	6	373	17	595	700	647
Socorro	5	32,508	101	3,535	46,718	43,190
Torrance	1	8	---	---	---	---
Total: 1961	40	7,750,637	6,201	217,035	282,755	261,404
1960	33	7,803,663	5,423	189,805	303,903	275,048

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Dona Ana	1	$540	---	---	---	---	$540
Grant	76,992	46,194,690	1,019	$209,996	21,153	$4,865,040	51,489,986
Hidalgo	2,506	1,503,720	100	20,538	1	299	1,732,105
Lincoln	(6)	90	6	1,133	2	402	1,949
Luna	1	570	---	---	---	---	637
Otero	29	17,310	2	330	---	---	17,816
Rio Arriba	(6)	30	---	---	---	---	30
Sandoval	1	840	2	443	(6)	58	1,362
Santa Fe	18	10,980	(6)	21	(6)	12	13,089
Sierra	4	2,430	13	2,688	11	2,530	8,890
Socorro	54	32,340	1,190	245,243	1,733	398,659	722,967
Torrance	(6)	60	---	---	---	---	60
Total: 1961	79,606	47,763,600	2,332	480,392	22,900	5,267,000	53,989,431
1960	67,288	43,198,897	1,996	467,064	13,770	3,552,660	47,683,474

[1] All lode mines, except for 1 placer mine in Santa Fe County.
[2] Opertions at various cleanups not counted as producing mines.
[3] Does not include tonnage of precipitates shipped or gravel washed.
[4] Includes 1 placer mine.
[5] Includes placer production and value: Gold—27 ounces, $945; silver—1 ounce, $1.
[6] Less than 0.5 ton.

Lead.—Lead ores were mined in eight counties, but 99 percent of the production came from three counties—Socorro, Grant, and Hidalgo. Lead output was 17 percent greater than in 1960. Lead-zinc mines in the Magdalena mining district, Socorro County, were closed in November.

Manganese Ore.—The manganese-ore mining industry in New Mexico continued to decline in 1961. Ferruginous manganese ore containing 10 percent manganese and 29 percent iron was mined by Luck Mining Co. from the Boston Hill mine in Grant County and shipped to The Colorado Fuel and Iron Corp. steel plant at Pueblo, Colo.

Molybdenum.—Molybdenum concentrate was produced by Kennecott Copper Corp. in the Chino concentrator at Hurley in Grant County. The molybdenum concentrate was recovered as a byproduct of the treatment of the copper concentrate produced from the Chino copper ore. The Molybdenum Corporation of America continued for the sixth year an exploration and development program, partly financed by a Defense Minerals Exploration Administration (DMEA) contract, at the Questa mine in Taos County. The corporation's annual report noted that 25 diamond-drill holes, having a total of 15,318 feet of penetration, and 3,109 feet of tunneling and drifting were completed in 1961. Samples from both drilling and tunneling showed a molybdenum content. The exploration indicated the existence of an unusually large area of molybdenum mineralization and in two sizable areas a much higher than average-grade content of molybdenum. In 1961, a large area of additional mining rights on lands adjacent to the property was acquired. The company held an aggregate area of approximately 20 square miles, all geologically similar to the area that was being explored.

TABLE 15.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	2	17	24	35	100	----------	----------
Dry gold-silver	6	48,235	1,316	73,268	1,232,900	197,900	----------
Dry silver	7	2,445	--------	843	69,600	29,300	22,000
Total	15	50.697	1,340	74,146	1.302.600	227.200	22,000
Copper	13	7,379,114	4,612	81,260	113,747,300	900	85,900
Lead	2	88	1	130	100	14,300	500
Lead-zinc and zinc [2]	6	313,238	214	126,645	1,011,200	4,267,400	45,689,900
Total	21	7,692,440	4,827	208,035	114,758,600	4,282,600	45,776,300
Other "lode" material:							
Copper precipitates	3	26,578	--------	--------	43,148,600	----------	----------
Lead-barite tailings	1	7,500	7	573	2,200	154,200	1,700
Total	4	34,078	7	573	43,150,800	154,200	1,700
Total "lode" material	39	7,777,215	6,174	282,754	159,212,000	4,664,000	45,800,000
Gravel (placer operation)	1	----------	27	1	----------	----------	----------
Total, all sources	40	7,777,215	6,201	282,755	159,212,000	4,664,000	45,800,000

[1] Detail will not necessarily add to totals because some mines produced more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.

TABLE 16.—Mine production of gold, silver, copper, lead, and zinc in 1961, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Concentration and smelting of concentrates [1]: Ore	4,809	206,494	114,242,900	4,420,300	45,774,200
Direct-smelting:					
Ore	1,365	76,260	1,686,800	243,700	25,800
Copper precipitates	----------	----------	43,148,600	----------	----------
Total	1,365	76,260	44,835,400	243,700	25,800
Other:					
Leaching of copper ore	----------	----------	133,700	----------	----------
Grand total	6,174	282,754	159,212,000	4,664,000	45,800,000

[1] Includes lead-barite tailing concentrate.

Silver.—Silver production was 7 percent less than in 1960. Leading silver mines were, in descending order of production, Atwood-Henry Clay, Hidalgo County; Kearney, Grant County; Linchburg, Socorro County; Bonney-Miser's Chest, Hidalgo County; and Hanover and Chino, Grant County. These mines produced 89 percent of the total output. Twenty-six percent of the silver was obtained from silver and gold-silver ores, 29 percent from copper ores, 29 percent from zinc ores, and 16 percent from lead and lead-zinc ores. A small part of the output was recovered as a byproduct in the treatment of lead-barite mill tailing.

Uranium.—New Mexico continued as the Nation's leading producer of uranium ore in 1961. Ore was mined at 76 operations in 4 counties—McKinley, 63; San Juan, 7; Valencia, 4; and Socorro, 2. Tonnage mined, 3.6 million, was 4 percent less than in 1960, but the grade, 0.22 percent U_3O_8, and the total value, $62.5 million, were higher.

Full ownership of Kermac Nuclear Fuels Corp., operator of the Nation's largest uranium mill, was acquired by Kerr-McGee Oil Industries, Inc., of Oklahoma City, Okla. Kermac officials estimated that 18 percent of the uranium produced in the United States from July 1, 1960 to June 30, 1961, was recovered at its 3,300-ton-per-day capacity mill, 25 miles north of Grants.

Homestake-Sapin Partners, Grants, took over the assets of Homestake-New Mexico Partners.

The drilling of large-diameter holes for use as ventilating shafts was one of the operating techniques used by the uranium industry in New Mexico in 1961. The largest diameter hole ever drilled with a rotary rig—721 feet deep and 90 inches in diameter—was completed and cased by Kermac Nuclear Fuels Corp. at the company's Section 24 mine in the Ambrosia Lake area. Installation of reinforced ¼-inch steelplate casing reduced the inside-diameter opening to 72 inches. Ventilation fans will circulate more than 100,000 cubic feet of air per minute through the shaft, which will also be used as an escape route for mine workers.

A ventilation shaft at Lance Corp. Blackjack No. 1 uranium mine was rotary drilled to a depth of 640 feet in less than 2 weeks. The hole was 42 inches in diameter and was cased with 36-inch-diameter tubing.

All uranium-ore processing mills in the Grants area obtained AEC uranium purchase contracts that extend through December 1966.

Vanadium.—Vanadium was recovered from some of the uranium ores mined in San Juan County in processing mills at Durango, Colo., and Shiprock. The vanadium recovery unit at the Navajo uranium plant of Kerr-McGee Oil Industries, Inc., at Shiprock operated throughout the year.

Zinc.—Zinc production increased 66 percent compared with 1960. Leading producing mines were Hanover and Kearney, Grant County, and Linchburg, Socorro County.

REVIEW BY COUNTIES

Mineral production was reported in all except 1 (Los Alamos) of the State's 32 counties. Only those counties with significant mineral production or those in which the production rate of cited minerals was materially changed in 1961 are discussed in the following review (see table 17 for additional details).

Bernalillo.—The value of mineral production in Bernalillo County was 21 percent higher than in 1960. Virtually all the output was used by the building and construction industries. All of the crushed limestone and gypsum and part of the clay and shale quarried in the county were used in the manufacture of portland and masonry cements at the Ideal Cement Co. Tijeras plant east of Albuquerque. Volcanic scoria was mined and used in the manufacture of building block and various-shaped concrete products by Edgar D. Otto & Son, Inc. Volcanic cinder was mined and similarly utilized by Lavaland Heights Block Co. Miscellaneous clays were mined and used by Kinney Brick Co., Inc., in the manufacture of brick and heavy clay products. In contrast to the increased output of these commodities, the output of sand and gravel declined to about two-thirds of that reported for 1960. Major sand and gravel producers included Albuquerque Gravel Products Co., Springer Transfer Co., Alameda Sand and Gravel Co., and Duke City Gravel Products.

Catron.—Additions were made to the salt-processing facilities at Salt Lake, northwest of Quemado, by Rocky Mountain Salt Co. Three solar evaporating ponds were constructed, and brine from Salt Lake was pumped into the ponds. Company officials estimated that one-half of the salt produced in 1961 was harvested from the newly constructed ponds.

Chaves.—The number of producing petroleum wells increased from 702 to 738; 4.5 million barrels of petroleum, an increase of 23 percent, was produced. The number of gas wells increased to three, and significant gas production was recorded. Limestone and caliche were quarried and crushed by the New Mexico State Highway Department.

Colfax.—The value of mineral production in Colfax County was 72 percent more than in 1960. Coal mining was the principal mineral industry, and the value of the coal production constituted 91 percent of the county total mineral production. Coal was mined by Kaiser Steel Corp. at the Koehler mine and washed and cleaned at a coal preparation plant. Ninety-seven percent of the cleaned coal was shipped by rail to the Fontana steel plant in California for use in the manufacture of coke. All of the coal produced by Rodman Coal Co. and by Julius Seidel was hauled from the respective mines by truck.

Dona Ana.—Two contractors and crews working for the New Mexico State Highway Commission, four contractors working for the Federal Government, and four independent operators produced sand and gravel. Volcanic scoria was quarried by five operators—Bailey-Lewis Co., Volcanic Cinder Co., Builders Block and Supply Co., Inc., Associated Materials Co., and Maynez Block Co. El Paso Brick Co. produced clay.

Eddy.—Eddy County ranked first in value of potassium salts mined, second in value of petroleum production, and second in total value of mineral production. Petroleum was produced from 3,602 wells—347 more than in 1960; petroleum production of 14 million barrels represented an increase of 24 percent for the year. The number of producing gas wells increased from 50 to 62.

TABLE 17.—Value of mineral production in New Mexico, by counties[1]

County	1960	1961[2]	Minerals produced in 1961 in order of value
Bernalillo	$6,364,524	$7,697,669	Cement, sand and gravel, stone, clays, gypsum, pumice, gem stones.
Catron	38,422	162,787	Sand and gravel, salt, gem stones.
Chaves[3]	11,062,962	13,795,200	Petroleum, sand and gravel, stone, gem stones.
Colfax	1,422,502	2,451,454	Coal, sand and gravel, stone.
Curry	96,473	78,696	Stone.
De Baca	226,392	(4)	Sand and gravel.
Dona Ana	525,339	588,906	Sand and gravel, pumice, clays, copper.
Eddy[5]	[6] 110,996,036	132,434,299	Potassium salts, petroleum, magnesium compounds, stone, salt, sand and gravel.
Grant	46,093,287	53,145,146	Copper, zinc, molybdenum, lime, sand and gravel, lead, silver, manganiferous ore, gold, stone, gem stones, iron ore, pumice.
Guadalupe	59,300	152,700	Sand and gravel.
Harding	(4)	(4)	Stone, carbon dioxide (natural).
Hidalgo	1,945,201	1,927,238	Copper, sand and gravel, gold, silver, lead, clays, gem stones, zinc.
Lea[5]	[6] 225,950,168	221,408,436	Petroleum, potassium salts, sand and gravel, stone.
Lincoln	63,352	378,902	Stone, sand and gravel, lead, pumice, zinc, silver, copper, gold.
Luna	45,010	68,921	Sand and gravel, gem stones, clays, stone, copper, silver.
McKinley[3]	49,191,539	50,150,295	Uranium ore, sand and gravel, petroleum, coal, clays, gem stones.
Mora	112,400	80,301	Stone.
Otero	331,490	322,834	Sand and gravel, stone, copper, lead, silver.
Quay	92,500	748,600	Sand and gravel.
Rio Arriba[5]	3,067,710	4,782,496	Petroleum, sand and gravel, pumice, stone, coal, mica (scrap), gem stones, copper.
Roosevelt[3]	3,795,674	11,334,892	Petroleum, sand and gravel, stone.
Sandoval[3]	261,311	347,655	Gypsum, sand and gravel, petroleum, pumice, coal, copper, lead, zinc, silver.
San Juan[5]	40,620,000	43,064,830	Petroleum, sand and gravel, helium, uranium ore, coal, vanadium, stone, gem stones.
San Miguel	129,680	23,541	Sand and gravel, stone.
Sante Fe	948,786	980,000	Sand and gravel, pumice, gypsum, copper, gold, silver, lead, zinc.
Sierra	54,222	112,578	Sand and gravel, stone, lead, zinc, copper, gem stones, silver, gold.
Socorro	1,153,005	999,388	Zinc, lead, sand and gravel, perlite, silver, copper, barite, gold, uranium ore.
Taos	(4)	2,138,006	Perlite, sand and gravel, mica (scrap), beryllium concentrate, gem stones.
Torrance	111,200	74,760	Sand and gravel, copper.
Union	292,752	462,359	Pumice, sand and gravel, stone.
Valencia	(4)	(4)	Uranium ore, sand and gravel, perlite, stone, pumice, gem stones.
Undistributed[7]	151,525,506	143,228,134	
Total[8]	[6] 653,226,000	688,908,000	

[1] Los Alamos is not listed, because no production was reported.
[2] Petroleum value is preliminary.
[3] Excludes natural gas.
[4] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[5] Excludes natural gas and natural gas liquids.
[6] Revised figure.
[7] Includes natural gas, natural gas liquids, and some gem stones, sand and gravel (1960), and mica (scrap and sheet—1960) that cannot be assigned to specific counties, and values indicated by footnote 4.
[8] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime and marketed potassium compounds.

Grant.—The major mineral industries in Grant County were those mining and processing ores containing copper, zinc, lead, gold, and silver. Much of the copper, all of the molybdenum, and part of the gold and silver came from ore mined by Chino Mines Division, Kennecott Copper Corp., at the Chino open-pit copper mine at Santa Rita. The Kennecott Copper Corp. annual report for 1961 disclosed that 7.1 million tons of ore—a decrease of 2 percent in tonnage compared with 1960 production—was mined and milled at the Chino operation. The average grade of the ore milled was 17.7 pounds of copper per ton, compared with 14.8 pounds per ton in 1960. Expansion of precipitating facilities for the recovery of copper from waste dumps led to an 18-percent increase in the tonnage of copper precipitate recovered. Of the total output of copper at Chino, 22,000 tons was obtained in the precipitating plant. Installation of a skip hoist with a capacity of 2,000 tons per hour in the Chino pit was virtually completed at yearend.

Some of the properties of the United States Smelting Refining and Mining Co. were operated by lessees. L. A. Patten & Associates, lessee, operated the Bayard (Continental) mine, the county's second largest producer of copper in 1961. Douglas B. White, lessee, Zuniga mine, continued bulldozer ripping mining of oxidized ores and the leaching of the mined ores throughout the year. Bruell & Bearup, lessee, Emma mine, installed concrete leaching vats and leached copper from ore obtained in cleaning up underground workings. Operations at the Emma mine were suspended the latter part of 1961. Copper precipitates were also sold by 23 operations, which recovered copper from the water of Santa Rita Creek below the Chino Santa Rita open-pit copper mine.

The New Jersey Zinc Co. Hanover mine was the principal producer of zinc ore in New Mexico. The Hanover mill was operated throughout the year on ore from the Hanover mine and the Linchburg mine (Socorro County), owned by the company and operated by L. A. Patten, lessee, until it was closed in mid-November. Negotiations were completed on September 6 whereby The New Jersey Zinc Co. leased the Oswaldo mine from Kennecott Copper Corp. Mine openings were rehabilitated preparatory to the mining of zinc ore in 1962.

The Kearney mine at Hanover and the selective flotation mill and treatment plant at nearby Deming reopened on January 2. According to the Hydrometals, Inc., annual report for 1961, these facilities were operated and the Pewabic mine, also near Hanover, was being developed as a joint venture by Hydrometals' Peru Mining Co. Division and The American Zinc, Lead and Smelting Co.

Hidalgo.—The value of the copper recovered constituted 87 percent of the total value of the metals produced in Hidalgo County in 1961. As in previous years, the Banner Mining Co. Bonney-Miser's Chest mine was the principal producer of copper. Banner Mining Co., in its annual report for 1961, listed production of 88,998 tons of ore, an increase of 9,272 tons compared with the output in 1960. The metal content of the 7,280 tons of concentrate produced from ores milled in 1961 was 1,654 ounces of gold, 38,217 ounces of silver, and 3,895,612 pounds of copper. Sinking of the Bonney shaft below the 1,560-foot level, a project started in 1960, was completed to the 1,790-foot level, and development work was started on the 1,760-foot level. Exploration and development consisted of 59 feet of shaft sinking, 2,429 feet of drifting, 2,436 feet of diamond drilling, and 618 feet of longhole drilling.

Brannan & Fuller produced lead- and copper-bearing gold-silver ore from the Atwood-Henry Clay and Eighty-Five mines and the Anita dump in the Lordsburg district. The ore was shipped to the American Smelting and Refining Company (Asarco) El Paso, Tex., smelter.

Lea.—Two-thirds of the petroleum produced in New Mexico in 1961 was obtained from wells in Lea County. Petroleum was produced from 9,173 wells, 343 more than in 1960, but the output was 3 percent less. The number of producing gas wells increased from 1,212 to 1,249.

Potassium-bearing salt was mined and refined by National Potash Co. southeast of Carlsbad.

Lincoln.—Gold-silver-copper-bearing lead-zinc ore was mined by New Frontier Mining & Milling Corp. from the Martha Washington mine and concentrated in the corporation mill 8 miles south of Capitan. Concentrate was shipped to the Asarco (El Paso, Tex.) smelter. These shipments contained all of the metals produced in Lincoln County in 1961.

Luna.—More gem stones, principally agate and Mexican onyx, were produced in Luna County than in any other county. A large part of the agate production was mined by Eddie Lindburg in an open-pit mine northwest of Columbus.

McKinley.—McKinley County was the leading producer of uranium ore in 1961. Seventy-four percent of the uranium ore mined in New Mexico was obtained from mines in the county. Major producing companies included Kermac Nuclear Fuels Corp., Phillips Petroleum Co., Homestake-Sapin Partners, Lance Corp., and Calumet & Hecla, Inc.

The tonnage of coal mined was a little more than one-half that produced in 1960. The output was from five mines—four were underground mines operated by Navajo Tribal Enterprises, Williams Coal Co., M.B.M. & O. Coal Co., and Clarksville Coal Co., and one was a strip mine operated by Howlett Coal Co. The number of petroleum producing wells increased from 55 to 66, and petroleum production was 14 percent more than in 1960.

Rio Arriba.—The number of producing petroleum wells increased from 132 to 180, and gas wells, from 1,183 to 1,219. Petroleum production increased 43 percent, compared with 1960. The Southern Union Gas Co. liquid petroleum products extraction plant at Lybrook was operated throughout the year. Output was 14 billion cubic feet of gas, from which 81,417 barrels of natural gasoline, 155,135 barrels of butane, and 228,541 barrels of propane were extracted. Residual gas from this operation, 13 billion cubic feet, was marketed through company pipelines. Coal was mined in three underground mines, one operated by Jose P. & Chris Carrillo, and two by McElroy Brothers. Production was 38 percent less than that of 1960.

A mobile mica processing and treatment plant was placed in operation in August at the Joseph mine by Alaska International Corp. The plant produced a clean mica product without the use of water. Morrison-Knudsen Co., Inc., quarried and crushed stone for use in the construction of Navajo Dam.

Roosevelt.—The greatest increase in petroleum production in New Mexico in 1961 occurred in Roosevelt County. Production of 3.8 million barrels was more than three times the 1960 output. The New Mexico Oil Conservation Commission reported that monthly production increased from 178,000 to 351,000 barrels and that the increase came from new oil wells. The number of producing wells increased from 53 to 114.

Washed and screened sand and gravel was produced by Sam Sanders from a pit 6 miles south of Portales.

Sandoval.—A large factor in the 33-percent gain in the value of the mineral production of Sandoval County, compared with that of 1960, was the production of gypsum by White Mesa Gypsum Corp. The company mined crude gypsum from a deposit near San Ysidro and it was trucked to the American Gypsum Co. wallboard plant at Albuquerque. Two firms, Big Chief Mining Co. and Lava-Pumice, Inc., quarried scoria. The output of coal increased 59 percent at the county's only coal mine, the Padilla mine, 7 miles south of Cuba. Petroleum production from 13 wells—one less than in 1960—was up 60 percent.

San Juan.—Ninety percent of the petroleum produced in northwest New Mexico in 1961 came from wells in San Juan County. Petroleum production increased 3 percent and was obtained from 1,407 wells, compared with 1,245 producing wells in 1960; the number of producing gas wells increased from 3,598 to 3,956. The tonnage of coal mined was 27 percent less than that of 1960. All of the production was from one mine, Hogback No. 13, operated by George R. Simpson & Hollis L. Tate.

Santa Fe.—Pumice was quarried by Copar Pumice Co., Inc., from a deposit west of Espanola and screened and crushed into marketable products at a processing plant at Pojoaque. Scoria was mined and used by Crego Block Co., Inc., in the manufacture of building block. Crude pumice obtained from Rio Arriba County was processed by James H. Rhodes & Co. at a plant in Santa Fe. The Clute Corp. mica grinding mill at Pojoaque processed sericite mica for use in the manufacture of texture paint, wallboard joint filling mixture, and plaster finishes. Feed for the mill was obtained from the Bat mine near Taos. Gypsum was mined by Kaiser Gypsum Co. and used in the manufacture of wallboard at the company plant at Rosario.

Sierra.—Most of the lead, zinc, copper, and silver produced in Sierra County was recovered from ore shipped from the Cuchillo Negro mining district by Sierra Minerals & Milling Corp. and lessors working the Cuchillo Negro mine dump. Small shipments of ore containing a few ounces of gold and silver and some copper were made to the Asarco (El Paso, Tex.) smelter by prospectors and claim holders doing annual assessment work.

Output of construction gravel, used for paving and produced by Brown Construction Co., was the largest mineral activity in the county.

Socorro.—Zinc-lead-copper-silver-gold-bearing ores were mined in the Magdalena mining district at The New Jersey Zinc Co. Linchburg mine by L. A. Patten, lessee; at the Nitt mine, by Wm. R. & Wm. L. Dobson; and at the Waldo mine, by Robert Chamberlin, lessee. A small quantity of ore was mined at the Queen group during exploration and development. All of the mines in the Magdalena mining district were closed prior to November 15. Lead concentrate containing copper, zinc, silver, and gold was obtained from selected tailing processed for the recovery of barite by Galbar, Inc., at the Mex-Tex barite mill at San Antonio. The mill was operated throughout the year and was New Mexico's only producer of barite. Uranium ore was mined by Lummus & Muriel and Big Tex Mining Co. and shipped to a plant at Ambrosia Lake area, McKinley County, for processing.

Operations at the Great Lakes Carbon Corp. perlite mine, mill, and expanding plant at Socorro were terminated in the spring. Part of the equipment was transferred to the company No Agua deposit in Taos County and to the company expanding plant at Antonito, Colo.

Taos.—Perlite accounted for most of the value of the mineral production in Taos County in 1961. Perlite was mined in the No Agua area in the northwest part of the county at open-pit mines operated by Great Lakes Carbon Corp., Johns-Manville Products Corp., and United Perlite Corp. Sericite mica-bearing pegmatite was mined at the Bat mine by Clute Corp. and trucked to the company grinding and processing mill north of Santa Fe. Los Compadres Mica Co. Ojo Caliente grinding mill was operated throughout the year by Vern Byrne. Mica-bearing mine dump rock and scrap mica produced by various small-scale mica miners in Rio Arriba County was purchased for plant feed. Plant output was used in the manufacture of roofing by Marvel Roofing Products, Inc., Albuquerque.

The Harding mine, near Dixon, produced hand-cobbed beryl.

Union.—Volcanic cinder was quarried by Twin Mountain Rock Co. near Des Moines.

Valencia.—The Anaconda Company began stripping operations at a new open pit at the Paguate mine, about 2 miles northwest of the Jackpile mine, near Bluewater. The uranium ore in the Paguate deposit is higher in grade and has a more favorable ratio of ore to overburden than reserves remaining in the company's Jackpile mine. Company officials announced that mining equipment and operations would be transferred piecemeal to the Paguate mine from the Jackpile mine, scheduled to close during late 1962.

All American Marble Co. quarried travertine from an extensive deposit about 30 miles southwest of Albuquerque and sawed and polished it in its plant at Albuquerque to produce decorative travertine products. United States Gypsum Co. mined and crushed crude perlite for shipment to company-owned plants in various parts of the United States.

The Mineral Industry of New York

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior and the New York State Science Service.

By Joseph Krickich,[1] Robert W. Metcalf,[1] and Madaline P. Stewart[2]

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VALUE of mineral production in New York declined 10 percent from the record high of $255 million in 1960 and was 6 percent less than in 1957, the next highest year. Virtually all commodities declined substantially in value except natural gas which gained 10 percent, lead and salt had about the same values as in 1960. Contributing factors to the decline were decreased demand for construction materials (cement, stone, sand and gravel, and gypum) and lower metal prices. Among the States, New York ranked first in talc and wollastonite production and was a major producer of cement, salt, gypsum, and zinc.

TABLE 1.—Mineral production in New York[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons..	1.172	$1,717	1,037	$1,373
Emery .... short tons..	8,169	142	6,180	106
Gem stones	(2)	9	(2)	10
Gypsum .... thousand short tons..	755	3,928	663	3,441
Iron ore (usable) .... thousand long tons, gross weight..	2,484	[3] 32,977	1,973	25,548
Lead (recoverable content of ores, etc.) ..... short tons..	775	181	879	181
Natural gas .... million cubic feet..	4.990	1,542	5,742	1,694
Peat .... short tons..	10.042	146	11,209	123
Petroleum (crude) .... thousand 42-gallon barrels..	1,813	8.412	[4] 1,715	[4] 8,163
Salt .... thousand short tons..	4,008	30,763	4,149	30,761
Sand and gravel .... do....	30,687	35,152	28,043	30,471
Silver (recoverable content of ores, etc.) thousand troy ounces..	49	45	40	37
Stone .... thousand short tons..	29,802	46,955	26,951	43,734
Zinc (recoverable content of ores, etc.) ...... short tons..	66,364	17,122	54,763	12,595
Value of items that cannot be disclosed: Abrasive garnet, beryl, cement, lime, talc, titanium concentrate, and wollastonite	....	81.831	....	76,219
Total New York[5]	....	[3] 255,368	....	228,983

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Revised figure.
[4] Preliminary figure.
[5] Total adjusted to eliminate duplicating value of clays and stone.

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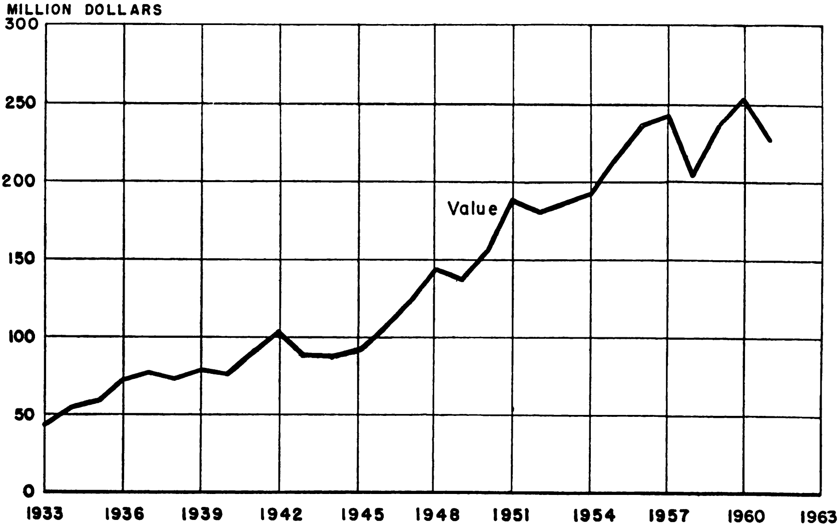

FIGURE 1.—Total value of mineral production in New York, 1933–61.

Employment and Injuries.—Preliminary data for selected mineral industries indicated that man-hours worked decreased by 2 million, compared with man-hours worked in 1960. Declines were recorded for all categories of mineral industry employment. The safety record of the selected industries did not improve in 1961. An increase of 10 injuries per million man-hours was recorded; however, the number of fatal injuries dropped from 10 to 6 in 1961.

TABLE 2.—Employment and injuries in selected mineral industries [1]

Industry	Men working daily	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:					
Cement	1,998	4,568,164	2	35	7.66
Clays [2]	84	135,034	-----	4	29.62
Coke ovens and smelters	1,981	5,589,598	1	105	18.78
Metal mines and mills	2,124	3,846,201	1	33	8.58
Nonmetal mines [3]	711	1,514,117	3	43	28.40
Quarries and mills [4]	2,667	5,413,665	2	123	22.72
Sand and gravel [5]	1,879	3,225,257	1	56	17.36
Total	11,444	24,292,036	10	399	16.43
1961: [6]					
Cement	1,874	3,988,202	-----	2	.50
Clays [2]	58	93,101	-----	-----	-----
Coke ovens and smelters	1,700	5,800,852	2	242	42.06
Metal mines and mills	2,649	4,163,197	1	141	34.11
Nonmetal mines [3]	566	1,242,342	2	34	28.98
Quarries and mills [4]	2,283	3,937,971	-----	135	34.28
Sand and gravel [5]	1,676	3,071,020	1	30	10.09
Total	10,806	22,296,685	6	584	26.46

[1] Production employees.
[2] Mines only.
[3] Includes emery, garnet, gypsum, salt, talc, mineral pigments, and wollastonite.
[4] Includes lime plants having no quarry operations.
[5] Preliminary figures.
[6] Commercial producers only.

Trends and Development.—New construction and modernization plans highlighted the State's mineral industries. Atlantic Cement Co., a new firm, was organized and began construction of a $64 million cement plant at Ravenna, Albany County. Initial annual capacity of the plant was to be 10 million barrels. Improvements were underway at other cement plants. Indicative of the growing demand for lightweight aggregate (expanded clay) materials was the expansion of the industry in the State. Construction began on two new lightweight aggregate plants along the Hudson River. An additional kiln was added to the Cohoes plant of Northern Lightweight Aggregates, Inc. An old lead-zinc mine in Sullivan County near Wurtsboro was reactivated, and plans for a new concentration mill were announced. Exploratory drilling continued at a wollastonite deposit in Essex County. Increased leasing activity by major oil companies was noted in the petroleum and natural gas industry.

The first power from the $720 million Niagara Power Project was produced in February after 3 years of construction. When completed, the Niagara Power Project will be the largest hydrodevelopment in the Western Hemisphere and will have a total capacity of 2,190,000 kilowatts.

In eastern New York on the Hudson River, 24 miles north of New York City, The Consolidated Edison Co. Indian Point atomic installation was nearing completion. This multimillion dollar plant will utilize a full mixture of thorium and uranium oxides; it has a cone 6½ feet in diameter by 8 feet in height and weighs more than 40 tons.

The New York State Office of Atomic Development investigated possible sites for processing residues from nuclear installations. A western New York location was expected to be chosen. This privately operated facility would reprocess nuclear fuels, store nuclear wastes, and extract radioactive byproducts.

The General Electric Co. Schenectady laboratories reported that manufactured diamonds up to a full one-tenth carat in size and of a quality satisfactory for industrial applications could be produced. The diamonds could be used in grinding and polishing wheels, one of the major markets for this material. Experimentally, too, diamonds as large as 1 carat had been produced but they lacked sufficient mechanical strength for industrial use.

General Electric Co. and Republic Aviation Co. developed electrospark forming techniques by which powerful shock waves formed under water blow metals into intricately contoured vacuum dies. Titanium, columbium, beryllium-copper, and stainless steel have been shaped experimentally by this method.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—In value, cement continued as New York's leading mineral commodity. Portland, masonry, and natural cements were produced; the portland type composed 95 percent of the total value. Production and shipments for all cements decreased. Compared with that in 1960, portland cement production decreased 12 percent; shipments decreased by 1.4 million barrels. Masonry cement shipments decreased 2,000 barrels from 1960; shipments of natural cement dropped sharply. The average value per barrel of portland cement increased from $3.32 in 1960 to $3.39; the average value of masonry cement dropped from $2.69 to $2.56. The average value of natural cement increased. Production was reported from 12 plants, 10 of which produced portland and masonry cements. One plant produced portland cement exclusively, and one plant produced masonry and natural cements. Greene County continued to lead in cement production. In decreasing order of value, other cement producing counties were Columbia, Ulster, Erie, Warren, Schoharie, and Onondaga.

The principal raw materials used for manufacturing portland cement were cement rock and limestone. Totals of 2.5 million tons of limestone and 2 million tons of cement rock were used. In addition, the following tonnages of raw material were consumed: Clay and shale, 280,000; gypsum, 127,000; sand and slag, 45,000; and iron materials, 25,000. Carbon black, air-entraining compounds, and grinding aids also were utilized.

Shipments of portland cement were made to consumers in New York, 13 other States, and foreign countries. Sixty-two percent of the shipments went to New York, 36 percent to New England States, 2 percent to New Jersey, and less than 0.5 percent to Pennsylvania and other States. Distribution of portland cement shipments by use was as follows: Ready-mixed concrete companies, 65 percent; highway and other contractors, 14 percent; building material dealers, 11 percent; concrete product manufacturers, 10 percent. Less than 0.5 percent was shipped to Federal, State, and local Government agencies and other customers. Fifty-nine percent of the finished portland cement was shipped by truck; the remainder was shipped by rail and water. Most of the shipments were in bulk. Small quantities were used by companies at the various plants.

Portland cement capacity increased 2 percent and totaled 24,956,000 barrels. Fifty-eight percent of capacity was wet process, and 42 percent, dry process. The industry consumed 401 million kilowatt-hours of electrical energy, of which 93 percent was purchased. Stocks of portland cement decreased 11 percent.

Atlantic Cement Co., Inc., owned jointly by Cerro Corp. and Newmont Mining Corp., began constructing a $64 million cement plant at Ravenna, Albany County. The plant was to have an annual capacity of 10 million barrels. Initially, two wet-process rotary kilns, measuring 19 feet in diameter at the feed end and 580 feet in length, were to be constructed. A limestone quarry with reserves capable of supplying anticipated requirements for more than 100 years was to be developed at the plant site. Included in the construction plans were dock facilities on the Hudson River capable of accommodating ocean vessels. Cement production was expected to begin in 1963.

Early in 1961, Marquette Cement Manufacturing Co., Chicago, Ill., acquired the Catskill and Howes Cave plants of North American Cement Corp. An $11 million modernization project was under way at the Catskill plant. A new kiln, to replace five old kilns, and three grinding mills were included in the project. Capacity was to be increased 50 percent to 2,500,000 barrels annually.

Alpha Portland Cement Co. increased cement storage capacity at its Cementon plant. The company also constructed a distribution terminal at Port Washington, Long Island.

Century Cement Manufacturing Co. installed a new vertical kiln and two grinding mills at its Rosendale plant. Glens Falls Portland Cement Co., Division of The Flintkote Co., completed a $1,250,000 construction program at Glens Falls. A new palletizing installation and four new silos with storage capacity for 93,550 barrels of cement were constructed. A $2 million cement storage and distribution plant was constructed near Rome by Lake Ontario Portland Cement Co., Ltd., Toronto, Ontario, Canada. Cement manufactured at Picton, Ontario, was to be shipped to the plant for redistribution.

Clays.—Reduced demand for miscellaneous clays and shale for making building brick and cement were the chief factors in the 12-percent decrease in clay output. Other uses, for clays however, including lightweight aggregate, art pottery, and artificial abrasives, increased 18 to 20 percent over 1960. Clay and shale used in making lightweight aggregate totaled 243,000 short tons, compared with 204,000 tons in 1960, indicating the increasing acceptance of this comparatively new industrial construction material. Albany slip clay, mined for years in the Albany district for use as a binder for certain artificial abrasive wheels and shapes, was produced from both Albany and Rensselaer Counties. The chief centers of clay output were in eastern and southeastern New York (Albany, Ulster, Orange, and Nassau Counties), central New York (Onondaga and Schoharie Counties), and western New York (Erie County). The plants usually were within marketing distance of the larger metropolitan areas. Twenty-five active operations were reported from 13 counties compared with 24 operations in 12 counties, in 1960.

Northern Lightweight Aggregates, Inc., a leading lightweight aggregate producer, increased capacity at its Cohoes plant by adding a second 175 by 11-foot rotary kiln, and additional crushing equipment. Nytralite Aggregates, Inc., a subsidiary of New York Trap Rock Corp., began constructing a new $2 million expanded shale lightweight aggregate plant at Kingston. The plant was to produce 500,000 cubic yards of aggregate annually when completed early in 1962. Hudson Valley Lightweight Aggregate Corp. planned to build a rotary-kiln lightweight aggregate plant at Saugerties.

Emery.—Three emery mines in Westchester County continued to be the only domestic sources of emery. Crude emery ore was shipped to consumers in New York and Massachusetts for processing and sold for general abrasive uses and as aggregate for heavy-duty nonslip floors. Output decreased because of imports of emery from Turkey.

Garnet (Abrasive).—Production of abrasive garnet, recovered in Essex and Warren Counties, decreased. The garnet produced in Warren County was processed for use in manufacturing sandpaper and for grinding and polishing glass. Refined garnet (andradite) produced in Essex County was recovered as a byproduct of wollastonite mining.

Gem Stones.—Gem material and mineral specimens were reported to have been found in Columbia, Essex, Fulton, Herkimer, Oneida, Putnam, and Warren Counties. The leading county for mineralogical interest was Warren County. Various mineral specimens, including garnet, quartz, hematite, magnetite, and selenite crystals were collected. Most of the mineral specimens were recovered by members of mineral and lapidary clubs.

Graphite (Manufactured).—Manufactured graphite was produced by National Carbon Co., Division of Union Carbide Corp. and Great Lakes Carbon Corp., in Niagara Falls. Output was used in anodes, electrodes, and lubricants as well as foundry and speciality uses. National Carbon Co. announced plans to install a large press, capable of exerting pressure up to 14,000 tons. The press was reported to be the largest graphite forming press in the world and would be used to make shapes weighing up to 30 tons.

Gypsum.—New York ranked sixth in crude gypsum production. Output came from five underground mines—three in Erie County and one each in Genesee and Monroe Counties. Most of the crude production was calcined at company-owned plants for use in manufacturing building material; some was used as a cement retarder. Calcined gypsum production totaled 1.2 million tons valued at $17.1 million, a 1-percent decrease in production compared with 1960. Calcined gypsum was produced at 7 plants in Bronx, Erie, Genesee, Monroe, Richmond, and Rockland Counties. Nationally, the State ranked first in production of calcined gypsum.

TABLE 3.—Crude gypsum production

(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value	Year	Active mines	Quantity	Value
1952-56 (average)	5	1,131	$4,110	1959	5	919	$4,663
1957	5	864	3,749	1960	5	755	3,928
1958	5	834	3,869	1961	5	663	3,441

Lime.—Although the number of lime-producing companies canvassed increased, compared with 1960, production of quicklime and hydrated lime decreased. International Paper Co., with plants at North Tonowanda and Ticonderoga, was added to the list of lime producers. The company recovered and used quicklime for manufacturing paper. Most of the lime produced was quicklime; less than 0.5 percent was hydrated for agricultural and chemical uses. Ninety-two percent of the total output was used by producing companies for chemical and industrial applications. Onondaga was the leading lime-producing county; other producing counties, in decreasing order of output, were Niagara, Erie, Essex, and Clinton.

Magnesium Compounds.—A small quantity of magnesium chloride was recovered as a byproduct of zirconium production at the Akron (Erie County) plant of Carborundum Metals Co., Division of The Carborundum Co.

Nitrogen Compounds.—E. I. du Pont de Nemours & Co., Inc., and Olin-Mathieson Chemical Corp. recovered atmospheric nitrogen used in manufacturing anhydrous ammonia at Niagara Falls, Niagara County.

Perlite.—Perlite mined in Western States was expanded at six plants—three in Erie County and one each in Bronx, Genesee, and Onondaga Counties. Production of expanded perlite totaled 14,000 tons, valued at $662,000, a 22-percent decrease in output compared with 1960. Eighty-six percent of the output was used for building plaster; the remainder was used for loose fill insulation, concrete aggregate, soil condtioning, filler material, filtering, and other uses.

Salt.—For the third consecutive year production of salt exceeded 4 million tons. The 1961 tonnage was a record high, although the value was virtually the same as in 1960. Lower average values for evaporated and rock salt were recorded; that for brine remained unchanged. Rock salt, used principally for manufacturing chemicals and highway ice control, was recovered from underground mines in Livingston and Tompkins Counties. Evaporated salt was recovered primarily by the vacuum-pan process and was used mostly for chemical manufacturing. Producing counties were Onondaga, Schuyler, Tompkins, and Wyoming Counties. Brine recovered in Onondaga and Schuyler Counties was used exclusively for manufacturing chemicals. Most of the salt was consumed in New York or other Northeastern States.

TABLE 4.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	3,561	$21,922	1959	4,011	$30,958
1957	3,691	28,002	1960	4,008	30,763
1958	3,896	30,609	1961	4,149	30,761

Sand and Gravel.—Production of sand and gravel decreased 9 percent, owing chiefly to decreased output by Government-and-contractor operations. Commercial production increased 2 percent mainly because of increased demand for paving material. Commercial output totaled 21.7 million tons and 86 percent was used as building and paving material, 51 percent as building material, and 35 percent as paving material. Output by Government-and-contractor operations consisted chiefly of paving and fill material used for road construction, maintenance, and repair.

Of the total commercial tonnage, 85 percent was transported by truck, 14 percent by water, and 1 percent by railroad. Ten percent of the commercial sand and gravel produced reached consumers as unprepared material. Over 2 million tons of sand and gravel were produced at each of two commercial plants; two operations produced over 1 million tons each and 5, over 500,000 tons each.

Sand and gravel was produced in 52 counties, 5 less than in 1960. The three leading counties—all with production in excess of 1 million tons—were Suffolk, Nassau, and Erie. New York ranked seventh in tonnage of sand and gravel produced and furnished 4 percent of the U.S. tonnage.

TABLE 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	8,398	$10,592	8,757	$10,215
Paving	4,003	4,704	5,087	5,525
Fill	701	231	597	233
Moulding	190	715	174	683
Filtration	19	32	10	12
Other	688	692	694	660
Gravel:				
Building	4,433	6,957	4,096	5,852
Paving	3,727	4,497	3,737	4,473
Railroad ballast	19	27	(1)	(1)
Fill	1,211	606	1,201	612
Other	1,390	1,169	930	772
Undistributed [2]	37	54	46	75
Total sand and gravel	24,816	30,276	25,329	29,111
Government-and-contractor operations: [3]				
Sand:				
Building	11	16	-----	-----
Paving	434	291	71	51
Fill	310	193	477	260
Other	279	73	229	88
Gravel:				
Building	93	81	-----	-----
Paving	3,516	3,191	1,003	368
Fill	1,191	1,010	875	571
Other	37	21	59	21
Total sand and gravel	5,871	4,876	2,714	1,359
Grand total	30,687	35,152	28,043	30,471

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes engine sand, railroad ballast sand, and data indicated by footnote 1.

[3] Includes data for State, counties, municipalities, and other government agencies.

TABLE 6.—Sand and gravel production by Government-and-contractors operations, by counties

(Short tons)

County	1960	1961
Albany	79,920	-----
Allegany	-----	-----
Broome	297,488	-----
Cattaraugus	22,890	11,940
Cayuga	3,699	-----
Chautauqua	239,851	199,443
Chemung	22,050	13,230
Chenango	117,378	-----
Clinton	624,658	-----
Columbia	(1)	35,000
Cortland	-----	-----
Delaware	79,451	21,821
Dutchess	36,139	29,039
Erie	-----	-----
Essex	14,128	9,500
Franklin	502,728	72,519
Fulton	-----	2,610
Genesee	49,711	31,412
Greene	180,380	-----
Hamilton	5,000	-----
Herkimer	34,039	25,246
Jefferson	658,521	144,986
Lewis	56,170	116,094
Livingston	15,000	13,440
Montgomery	30,081	4,579
Niagara	11,360	-----
Oneida	126,000	16,050
Onondaga	80,908	6,504
Ontario	28,751	16,455
Orange	71,960	75,842
Orleans	12,852	16,167
Oswego	54,000	50,000
Otsego	121,565	45,900
Rensselaer	76,130	-----
St. Lawrence	351,201	51,764
Saratoga	552,352	54,393
Schenectady	121,504	11,463
Schuyler	37,376	35,500
Schoharie	12,575	-----
Seneca	17,660	5,962
Steuben	108,700	108,700
Suffolk	(1)	-----
Sullivan	285,632	-----
Warren	238,167	-----
Washington	115,188	12,600
Wayne	75,983	89,116
Yates	18,000	-----
Undistributed [2]	283,466	1,387,037
Total	5,870,612	2,714,312

[1] Figure withheld to avoid disclosing individual company confidential data, included with "Undistributed."

[2] Includes data unspecified by counties and data indicated by footnote 1.

Stone.—Total stone production decreased 10 percent and was $3.2 million less than in 1960. The chief factor for the decline was decreased demand for crushed and broken stone for all major uses, including concrete aggregate, riprap, flux, railroad ballast, and agricultural uses. Compared with 1960, dimension stone increased 5 percent in tonnage and 10 percent in value.

Stone (basalt, granite, marble, miscellaneous stone, sandstone, limestone, and slate) was produced in 39 of the 62 counties. Counties producing over $2 million, in decreasing order, were Dutchess, Niagara, Rockland, Onondaga, Erie, Ulster, and Monroe. In addition, Oneida, Greene, Albany, Montgomery, and Genesee Counties each produced over $1 million.

Output of limestone, the leading stone produced, decreased 11 percent chiefly because of less demand for stone used in the construction of the Niagara Power Project in Niagara County. All major uses for limestone declined. A limited output of dimension limestone in Albany County was reported by Government-and-contractor operations. In addition to Albany and Niagara Counties, production of limestone by Government-and-contractor operations was reported in Jefferson and Lewis Counties. The leading counties for commercial production were Dutchess and Onondaga.

TABLE 7.—Crushed and broken limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1960		1961	
	Quantity	Value	Quantity	Value
Riprap	245	$357	85	$133
Concrete aggregate and roadstone	18,328	28,745	16,148	25,669
Fluxing stone	78	170	63	102
Agricultural	499	1,466	426	1,240
Railroad ballast	400	647	327	532
Cement and lime	5,544	5,213	5,034	5,188
Miscellaneous uses	1,881	3,224	1,952	3,449
Total	26,975	39,822	24,035	36,313

Production of basalt (traprock), the State's second ranking stone, increased compared with 1960. Rockland continued as the only producing county. Sandstone was quarried and marketed both as dimension stone and as crushed stone, and it continued to rank third in value. Although output of dimension stone decreased, value increased less than 1 percent. Dimension sandstone was sold mainly for construction, curbing, flagging, and sawed and dressed architectural stone. Production and value of crushed sandstone increased. Sandstone was produced in 10 counties, led by Delaware, Sullivan, and Broome Counties.

Output of slate increased mainly because of greater demand for dimension slate for roofing and flagging. Some crushed and broken slate was produced. Washington County continued as the center of the slate industry. Dimension granite for construction and architectural uses was produced in Westchester County. Crushed granite for concrete aggregate and other uses was produced in Warren County.

Miscellaneous stone, used chiefly for concrete aggregate, was produced in Clinton and Rensselaer Counties. Marble was produced in St. Lawrence and Westchester Counties.

Talc.—Production of talc increased slightly and came from underground mines in St. Lawrence County. Two companies operated the mines and the nearby grinding mills. Ground talc was marketed principally for use in ceramics and paint manufacturing. New York continued as the leading talc-producing State.

Vermiculite.—Exfoliated vermiculite was produced in Oneida County from crude material shipped from Montana and South Carolina.

Wollastonite.—Wollastonite used as a filler in paints, ceramics, and plastics was produced by Cabot Minerals Division, Cabot Corp., in Essex County. Adirondack Development Corp. continued its exploratory drilling for wollastonite at the Deerhead mine near Lewis in Essex County.

METALS

Aluminum.—New York was the fifth largest producer of aluminum among the 13 producing States in tonnage and ranked fourth in value. Output increased moderately over that of 1960. Aluminum Company of America and Reynolds Metals Co., both at Massena, St. Lawrence County, were the only producers. The combined capacity of the two plants operated by these firms approximated 10 percent of the primary aluminum capacity of the United States. The Reynolds Metals Co. reduction plant was completed during the year.

Beryllium.—Beryl obtained from the Bedford feldspar quarry in Westchester County was sold through the General Services Administration. This quarry had been inactive for many years before its reactivation in 1960. Output, though still small, increased substantially over 1960. Lapp Insulation Co. in LeRoy, Genesee County, was among the five domestic consumers of cobbed beryl and used ground beryl for manufacturing high-voltage electrical porcelain.

Ferroalloys.—Production and shipments of ferroalloys decreased 51 and 37 percent, respectively, to 73,000 and 86,000 short tons. The value of shipments dropped 36 percent to the lowest point in many years and totaled $20.1 million. In volume of shipments, however, New York ranked seventh among the 19 ferroalloy-producing States, and in total value of shipments, it ranked fifth. Substantial declines

TABLE 8.—Ferroalloy producers in 1961

Company	Location	Type of furnace	Ferroalloys produced [1]
Hanna Furnace Corp.	Erie County, Buffalo	Blast	Silvery pig iron.
Pittsburgh Metallurgical Co.	Niagara County, Niagara Falls.	Electric	FeMn, SiMn, FeSi, FeCr, silvery pig iron.
Titanium Alloy Manufacturing Division of National Lead Co.	do	do	FeTi, FeB, FeZr.
Union Carbide Metals Co.	do	do	FeCr, FeTi, FeW, FeB, FeCb, FeCbTa, SiMn, FeSi.
Transition Metals & Chemical Co.	Ulster County, Wallkill	Thermit	FeCb.

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[1] Symbols: FeMn, ferromanganese; SiMn, silicomanganese; FeSi, ferrosilicon; FeCr, ferrochromium; FeTi, ferrotitanium; FeW, ferrotungsten, FeB, ferroboron; FeCb, ferrocolumbium; FeCbTa, ferrocolumbium-tantalum; FeZr, ferrozirconium.

in production and shipments of silvery pig iron, ferrochromium, and ferrotitanium constituted the chief factors in this lower scale of activity. Shipments of silicomanganese, ferrosilicon, ferrotungsten, and ferrocolumbium-tantalum also were lower. Ferrochrome-silicon, ferromanganese, ferroboron, and ferrocolumbium production and shipments were moderately higher than in 1960.

Iron Ore.—Shipments of usable iron ore dropped 21 percent in quantity and 23 percent in value to about 2 million long tons valued at $25.5 million, approximately the same level as for 1959. The bulk of the ore produced was magnetite, most of which was shipped as agglomerate (largely sinter), and the balance, as concentrate. A small quantity of hematite was dried and pulverized for use as pigment material. The magnetite was mined by three companies from four mines—two mines in Essex County and one mine each in Clinton and St. Lawrence Counties. The hematite came from an underground mine in Oneida County. Over 92 percent of the magnetite was mined from open pits, compared with 85 percent in 1960.

Iron and Steel.—Both production and shipments of pig iron decreased; production totaled 3.8 million short tons, of which basic pig iron comprised 83 percent. The balance included, in decreasing order of output, malleable, bessemer, foundry, and low-phosphorus pig iron. No direct casting pig iron was reported in 1961. Receipts of ore at New York plants were mostly of domestic origin, although sizable tonnages of ore were received that originated in Canada (chiefly Labrador), Chile, Liberia, and Sweden. Manganiferous ore came largely from Labrador; smaller tonnages were received from Brazil, India, Mexico, and South Africa. Other raw materials consumed in blast furnaces included limestone, dolomite, mill cinder and roll scale, open-hearth and bessemer slag, coke, coke breeze, and ferrous scrap. Pig iron was manufactured by five companies at six plants in three counties—four plants in Erie County, and one plant each in Niagara and Rensselaer Counties. Seventeen stacks were active in 1961. Three open-hearth and six electric furnaces produced steel. All the open-hearth furnaces were in Erie County.

Shenango Furnace Co. in Pittsburgh, Pa., began constructing an ingot-mold foundry with an annual capacity of 120,000 tons on a site adjacent to the Hanna Furnace Corp. blast-furnace plant in Buffalo. The new plant's iron requirements were to be delivered as hot metal directly from the blast furnaces. As one phase of a research program, Hanna Furnace Corp. installed the first coal-injection equipment ever made for use on a commercial blast furnace. Results to yearend indicated that coal can be used on a pound-for-pound basis to replace a significant quantity of the coke used as blast furnace fuel, with resulting economies. A pilot cupola furnace also was installed at the Hanna Furnace plant for the development of new and improved grades of merchant pig iron.

To reduce the clouds of red dust from the open-hearth exit stacks at its Lackawanna plant, Bethlehem Steel Co. installed electrostatic dust precipitators. More than 95 percent of the dust resulting from the oxygen-lance method of making steel was eliminated.

Iron and Steel Scrap.—New York ranked sixth in consumption of ferrous scrap and pig iron among States whose figures can be separately published and accounted for 5 percent of the total U.S. consumption. Consumption in the State totaled 5.9 million tons, 9 percent less than in 1960. Pig iron comprised 54 percent of consumption. Pig iron and scrap consumption decreased 5 and 14 percent, respectively. Consumer stocks of ferrous scrap on December 31 totaled 623,000 short tons, an increase of 10 percent over 1960, while stocks of pig iron declined 15 percent to 431,394 tons.

Lead.—Output of lead from the Balmat mine in St. Lawrence County increased 13 percent and was the highest since 1957. Production, however, was much less than in the years immediately preceding 1957. The value of output remained about the same as in 1960, owing to a 12-percent decrease in the average value per pound. Exploration and investigation by a New Jersey firm in a former lead-producing area near Wurtsboro, Sullivan County, resulted in leasing of the McDonald property and the building of a new concentration mill.

Lead products manufactured included black lead oxide by Electric Auto-Lite Battery Corp. in Niagara Falls, and red lead and litharge by the National Lead Co. in Brooklyn.

Mercury.—Industrial consumption of mercury rose 9 percent to 55,000 flasks, the largest quantity since 1955 and only 2 percent below the peacetime record of that year. Contributing to this high consumption was the installation in the last half of the year of a mercury-cell chlorine and caustic soda plant at Niagara Falls.

Silver.—Silver was recovered as a byproduct of lead-zinc ore from the Balmat mine in St. Lawrence County. Production was 18 percent less than in 1960. Average price per troy ounce rose from 90.505 cents to 92.449 cents.

TABLE 9.—Mine production of silver, lead and zinc, in terms of recoverable metals

Year	Mines producing	Material sold or treated (short tons)	Silver		Lead		Zinc		Total value (thousands)
			Troy ounces	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)	2	610, 825	51, 838	$47	1, 277	$375	49. 898	$12. 683	$13, 105
1957	2	660, 638	63, 880	58	1, 667	477	64, 659	15. 001	15, 536
1958	2	563, 644	66, 738	60	579	136	53. 014	10. 815	11,011
1959	2	438, 769	51, 588	47	481	111	43, 464	9, 997	10, 155
1960	2	701, 197	49, 324	45	775	181	66, 364	17, 122	17, 348
1961	2	592, 438	40, 507	37	879	181	54, 763	12, 595	12, 814

TABLE 10.—Mine production of silver, lead, and zinc in 1961, by months, in terms of recoverable metals

Month	Silver (troy ounces)	Lead (short tons)	Zinc (short tons)	Month	Silver (troy ounces)	Lead (short tons)	Zinc (short tons)
January	4, 694	73	4, 662	August	3, 128	55	4, 926
February	3, 605	84	4, 690	September	3, 156	66	4, 437
March	3, 671	72	4, 707	October	2, 623	63	4, 838
April	2, 923	76	4, 091	November	3, 198	88	4, 218
May	3, 607	63	4, 701	December	3, 935	97	4, 098
June	2, 936	79	4, 888				
July	3, 031	63	4, 507	Total	40, 507	879	54, 763

Tantalum-Columbium.—Union Carbide Metals Co., Niagara Falls, increased its output of tantalum. Stauffer Chemical Co., also in Niagara Falls, produced tantalum in quantity for the first time during the year. The sharp increase in tantalum production was accompanied by a corresponding rise in the price of tantalite. Stauffer Chemical Co., also produced columbium during the year.

Titanium Concentrate (Ilmenite).—Production and shipments of ilmenite increased slightly, although the average value per ton decreased about one-eighth compared with 1960. The ilmenite was recovered from titaniferous magnetite ore near Tahawus, Essex County, and used mostly for pigments.

Uranium.—Uranium carbide and plutonium carbide were manufactured by The Carborundum Co., Niagara Falls, for use as fuel for nuclear power reactors.

Zinc.—Zinc production in New York decreased 17 percent to 54,763 short tons, and changed the State's rank from second to third in the Nation. Value decreased 26 percent, reflecting an 11-percent decline in average value per pound. Zinc was mined at the Balmat and Edwards mines in St. Lawrence County.

Zirconium.—No commercial zircon was produced in New York. However, zircon and zirconia refractories were manufactured by Harbison-Carborundum Corp., Falconer, Chautauqua County, and Corhart Refractories Co., Corning, Steuben County. Zirconium oxide also was made in Niagara Falls area by Norton Co. and by Titanium Alloy Manufacturing Division, National Lead Co. Zirconium ferroalloys were manufactured by Union Carbide Metals Co. at Niagara Falls.

MINERAL FUELS

Coke and Coal Chemicals.—New York ranked eighth in quantity and seventh in value among coke-producing States. Output declined to 2.7 million short tons valued at $45 million. Average value per ton was $17.00, compared with $17.21 in 1960. Three companies produced coke and coal chemicals at one merchant plant and at two furnace plants in Erie County.

New York consumed 3 million tons of coke in 1961. Over 94 percent was charged into blast furnaces. Most of the remainder was consumed in foundries and other industrial plants. Residential heating, in past years a substantial market for coke, consumed less than 1 percent of the output because of the greatly increased use of electricity, oil, and gas for domestic space heating. In addition to coke, 161,000 tons of coke breeze (finely divided material) was used for fuel.

A multimillion dollar replacement and modernization program was undertaken by Donner-Hanna Coke Corp. in Buffalo. Jointly owned by Republic Steel Corp. and Hanna Furnace Co., Donner-Hanna planned to build a battery of 50 new coke ovens and auxiliary equipment, including new coal-handling equipment and coal-chemical facilities, to be constructed by Koppers. Semet-Solvay Division, Allied Chemical Corp., also constructed a new battery of coke ovens at its Tonawanda plant. The installation consisted of 60 vertical-type flue ovens.

Natural Gas.—Production of natural gas increased 15 percent to 5,742 million cubic feet. The gas was recovered mostly from the Medina and Oriskany formations. According to the American Gas Association, the proved reserve of natural gas as of December 31 totaled 128,324 million cubic feet, an increase of one-third from 1960. This increase was due chiefly to a large rise in underground storage, which comprised 71 percent of the total reserve. Virtually all the remainder consisted of free gas not in contact with crude oil in reservoirs (nonassociated storage). A small quantity was produced from the Lebanon pool in the Clinton-Medina formation in Madison County, the most easterly producing gas pool in the State.

The year was characterized by a substantial increase in the leasing activities of the major oil companies. In particular, large blocks of land were leased by Humble Oil Co. and Gulf Oil Co. Humble leased about 100,000 acres east of Lake Ontario and Gulf leased more than 775,000 acres in Delaware County and vicinity. Atlantic Oil Co., Mobil Oil Co., Ohio Oil Co., Skelly Oil Co., Texaco, Inc., and Tidewater Oil Company, were interested in the oil and gas potential in the State. The major interest in exploratory wells in 1961 was the Medina sandstone, although 10 percent of the wells were drilled below the Medina formation to test deeper formations in eastern, central, and western New York. Exploratory test wells were drilled in 17 counties; most of these, however were in Cattaraugus, Livingston, and Ontario Countries. Of the 11 natural gas field wells completed during the year, 7 were 1,250 to 2,500 feet deep and 4 were 2,500 to 3,700 deep; of the 5 gas wildcats, 2 were drilled to depths of 1,250 to 2,500 feet, and 1 each, to depths of 2,500 to 3,750 feet, 3,750 to 5,000 feet, and 7,500 feet.

According to a survey by Oil and Gas Journal,[8] gas storage facilities were maintained by 5 companies at 15 locations in western and central New York. These firms were Home Gas Corp. (3 areas), Iroquois Gas Corp. (9 areas), New York State Natural Gas Corp. (1 area), Sylvania Corp. (1 area), and Tennessee Gas Pipeline Co.-Iroquois (1 area). Total storage capacity in natural gas reservoirs was estimated to be 101,950 million cubic feet, of which 55,470 million cubic feet was listed as working-gas capacity and 46,480 million cubic feet, as required cushion gas.

Peat.—Three firms, one each in Orange, Seneca, and Westchester Counties, produced reed-sedge and humus peat. Output rose 12 percent but was still 13 percent below 1959. Value, however, dropped 15 percent compared with 1960. Some peat was packaged before sale, but sales mostly were in bulk. According to reports from producers, New York was the sixth largest consumer of peat in 1961. Shipments into the State totaled 36,920 short tons, compared with 38,903 tons in 1960. Peat was used for a variety of agricultural and horticultural purposes; nearly 95 percent was used for general soil improvement.

Petroleum.—Output of petroleum decreased 5 percent to 1.7 million barrels. Petroleum came from Allegany, Cattaraugus, and Steuben Counties in the southwestern part of the State. The average value per barrel was $4.76. The posted price at the beginning of the year was $4.80 per barrel. On December 13 the price of Cattaraugus County crude dropped to $4.63, and Allegany County crude, to $4.74, while one firm continued to pay $4.80. This price situation was in effect at the end of the year. The number of productive wells at yearend was estimated to be 14,359. Of these, 13,250 were artificial lift oil wells, 1,105 were gas wells, and 5 were condensate gas wells. Virtually all the New York crude oil was processed in Pennsylvania refineries.

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[8] Bizal, Robert B. Gas-Storage Capacity Spurts. Oil and Gas J., v. 60, No. 20, May 14, 1962, pp. 125–138.

The proved reserve of crude petroleum as of December 31, as reported by the American Petroleum Institute, totaled 27.7 million barrels—a reduction of 15 percent. There were no new discoveries in 1961; the decrease represented production plus a sizable downward revision in reserves.

New wells drilled comprised 400 cable-tool wells and 26 rotary-drilled wells. The average depth was 1,443 feet. All field oil wells and service wells were drilled to depths between 1,250 and 2,500 feet. All except one of the dry field wells were in the comparatively shallow range of 1,250 to 2,500 feet. The one exception reached a depth between 2,500 and 3,750 feet. No crude oil wildcat wells were reported All but three of the dry wildcat wells were from 2,500 to 7,500 feet in depth; these three were in the 1,250- to 2,500-feet range.

Capacity of refineries and cracking plants remained at about the same level as in 1960—90,500 and 32,300 barrels per day, respectively. Plants were operated by Mobil Oil Co. at Buffalo, Erie County, and Brooklyn, Kings County, and by Frontier Oil Refining Corp., Division of Ashland Oil & Refining Co., at Tonawanda, Erie County. The plant at Brooklyn had skimming and cracking facilities, and the other two were skimming, cracking, and asphalt plants. Texaco, Inc., continued to operate its research laboratory at Beacon, Dutchess County.

TABLE 11.—Petroleum production

(Thousand barrels and thousand dollars)

Year	Quantity	Value	Average value per barrel	Year	Quantity	Value	Average value per barrel
1952–56 (average)	3,390	$13,548	$3.99	1959	1,970	$8,353	$4.24
1957	2,677	12,662	4.73	1960	1,813	8,412	4.64
1958	1,763	7,457	4.23	1961 [1]	1,715	8,163	4.76

[1] Preliminary figures.

TABLE 12.—Well completions and drilling footage for field wells and wildcats, in 1961

Type of well	Field wells		Wildcats		Total	
	Well completions	Drilling footage	Well completions	Drilling footage	Well completions	Drilling footage
Crude	230	307,875			230	307,875
Gas	11	25,416	5	14,630	16	40,046
Dry	15	22,126	13	41,402	28	63,528
Service	152	203,275			152	203,275
Total	408	558,692	18	56,032	426	614,724

Source: Oil and Gas Journal, v. 60, No. 5, Jan. 29, 1962.

REVIEW BY COUNTIES

Production of minerals was reported from 55 counties, compared with 57 in 1960. Although value decreased for most counties, increased values were reported in 17 counties, notably Ulster County, where cement production increased. In decreasing order of value,

TABLE 13.—Value of mineral production in New York, by counties[1][2][3]

County	1960	1961	Minerals produced in 1961 in order of value
Albany	(4)	(4)	Stone, sand and gravel, clays.
Allegany	$395,059	$311,190	Sand and gravel.
Broome	(4)	1,023,096	Sand and gravel, stone, clays.
Cattaraugus	827,940	833,722	Sand and gravel.
Cayuga	(4)	542,243	Stone, sand and gravel.
Chautauqua	309,369	160,884	Sand and gravel.
Chemung	235,975	(4)	Sand and gravel, clays.
Chenango	(4)	(4)	Sand and gravel.
Clinton	(4)	(4)	Iron ore, stone, sand and gravel, lime.
Columbia	(4)	(4)	Cement, sand and gravel, stone, clays, gem stones.
Cortland	----------	116,430	Sand and gravel.
Delaware	(4)	(4)	Stone, sand and gravel.
Dutchess	(4)	(4)	Stone, sand and gravel, clays.
Erie	21,430,132	16,275,157	Cement, stone, sand and gravel, gypsum, lime, clays.
Essex	(4)	(4)	Ilmenite, iron ore, wollastonite, lime, sand and gravel, garnet, gem stones.
Franklin	(4)	178,582	Stone, sand and gravel.
Fulton	77,157	120,639	Sand and gravel, gem stones.
Genesee	2,981,712	2,746,949	Gypsum, stone, sand and gravel.
Greene	(4)	(4)	Cement, stone, sand and gravel.
Hamilton	5,000	----------	
Herkimer	(4)	(4)	Stone, sand and gravel, gem stones.
Jefferson	(4)	1,172,171	Stone, sand and gravel.
Lewis	(4)	(4)	Do.
Livingston	(4)	(4)	Salt, sand and gravel, stone.
Madison	(4)	387,341	Stone.
Monroe	3,184,620	3,087,608	Stone, sand and gravel, gypsum.
Montgomery	(4)	(4)	Stone, sand and gravel.
Nassau	7,413,033	6,957,741	Sand and gravel, clays.
Niagara	10,693,100	(4)	Stone, lime, sand and gravel.
Oneida	2,561,882	(4)	Stone, sand and gravel, iron ore, gem stones.
Onondaga	(4)	(4)	Lime, salt, stone, cement, sand and gravel, clays.
Ontario	(4)	(4)	Sand and gravel, stone.
Orange	1,432,480	1,172,566	Sand and gravel, clays, peat, stone.
Orleans	(4)	(4)	Stone, sand and gravel.
Oswego	(4)	(4)	Sand and gravel.
Otsego	(4)	(4)	Stone, sand and gravel.
Putnam	(4)	(4)	Sand and gravel, stone, gem stones.
Queens	6,282	----------	
Rensselaer	(4)	(4)	Stone, sand and gravel, clays.
Rockland	(4)	(4)	Stone, sand and gravel.
St. Lawrence	41,489,959	35,280,891	Iron ore, zinc, talc, stone, lead, sand and gravel, silver.
Saratoga	(4)	(4)	Sand and gravel, stone.
Schenectady	(4)	(4)	Sand and gravel.
Schoharie	(4)	(4)	Cement, stone, clays.
Schuyler	(4)	(4)	Salt, sand and gravel.
Seneca	(4)	(4)	Peat, sand and gravel.
Steuben	(4)	(4)	Sand and gravel.
Suffolk	6,719,375	6,946,922	Do.
Sullivan	(4)	(4)	Stone, sand and gravel.
Tioga	300,306	350,867	Sand and gravel.
Tompkins	(4)	(4)	Salt, stone, sand and gravel.
Ulster	(4)	(4)	Cement, stone, clays, sand and gravel.
Warren	(4)	(4)	Cement, garnet, stone, sand and gravel, gem stones.
Washington	431,456	789,646	Stone, sand and gravel.
Wayne	(4)	(4)	Do.
Westchester	773,812	730,334	Stone, sand and gravel, emery, peat, beryl.
Wyoming	(4)	(4)	Salt, stone.
Yates	6,300	----------	
Undistributed[5]	154,093,020	149,798,284	
Total	255,368,000	228,983,000	

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[1] Bronx, Kings, New York, and Richmond Counties are not listed because no production was reported.

[2] Fuels, including natural gas and petroleum, not listed by counties; value included with "Undistributed."

[3] Excludes value of clays and stone used in manufacturing lime and cement.

[4] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[5] Includes natural gas and petroleum, some gem stones and sand and gravel that cannot be assigned to specific counties, and value indicated by footnote 4.

the leading mineral-producing counties were St. Lawrence, Erie, Onondaga, Greene, and Ulster.

Albany.—Limestone for concrete aggregate, railroad ballast, agstone, blast furnace flux, and riprap was produced at South Bethlehem by Callanan Road Improvement Co. Heldeberg Bluestone & Marble, Inc., East Berne, produced dimension sandstone. Albany Gravel Co., Inc., operated pits near Bethlehem, Cedar Hill, and Loudonville. Bank-run paving gravel was produced by James H. Maloy, Inc., Albany. Whitehead Bros. Co. produced molding sand from pits near Selkirk and Slingerland.

The County continued to rank second in clay output despite a decrease from 1960. Production of miscellaneous clay dropped from 228,000 tons to 197,000 tons. Powell & Minnock Brick Works, Inc., and Sutton & Suderly Brick Co., both near Coeymans, mined miscellaneous clay for manufacturing building brick. Roah Hook Brick Co., Coeymans, did not operate during the year. Expanded lightweight aggregate was manufactured by Northern Lightweight Aggregates, Inc., Cohoes, from shale mined nearby. Clay for abrasives and flowerpots was produced by Rex Clay Products Co., Inc., in Albany.

Allegany.—Sand and gravel, used mainly for building and paving, was produced by Alfred Atlas Gravel and Sand Corp. and Buffalo Slag Co., Inc., both near Alfred, and by Thomas Moogan in Friendship. Nick Codispoti, Belmont, produced sand for controlling ice on highways.

Bronx.—Crude gypsum was calcined at the Bronx plant of National Gypsum Co. The company also expanded perlite shipped from Colorado for use in manufacturing building plaster. Most of the material was shipped to other company plants for manufacturing building materials. The remainder was used at the Bronx plant.

Broome.—Sand and gravel, used mainly for building and paving, was produced by Barney & Dickenson, Inc., Winnie & Son., Inc., and Bob Murphy, Inc., all near Vestal, and by Binghamton Sand & Crushed Stone Corp. and Weber's Sand & Gravel, both near Binghamton. Output decreased compared with 1960. Crushed and broken sandstone for concrete aggregate and riprap was produced by Corbisello Quarries in Binghamton. Dimension sandstone (bluestone) was quarried and shipped to Delaware County for fabrication. Binghamton Brick Co., Inc., in Binghamton mined miscellaneous clay for manufacturing building brick.

Cattaraugus.—Production of commercial sand and gravel was virtually the same as in 1960 and totaled 684,000 tons. Output consisted mainly of processed building and paving material and was shipped to consumers principally by truck. Eight pits, 3 near Allegany, and one each near Franklinville, Gowanda, Limestone, Onoville, and Red House, were active.

Cayuga.—Limestone for concrete aggregate, railroad ballast, and asphalt filler was quarried and crushed by General Crushed Stone Co. at Auburn. J. J. Harrington and Jay W. Robinson & Son, both near auburn, produced processed sand and gravel used mainly for building and paving. The Mentz pit of Stanley Jablonski was idle.

Chautauqua.—Commercial sand and gravel was produced by A. & K. Builders Supplies, Inc., and W. Lee Bull, Inc., both near Jamestown, and Sack's pit at Bemus Point. Output was primarily processed material used for building and paving.

Chemung.—Commercial sand and gravel was recovered from pits near Horseheads, Elmira, and Breesport. Output was primarily processed material used for building and paving. Consolidated Brick Co. in Horseheads mined miscellaneous clay for manufacturing building brick.

Chenango.—Bundy Concrete Co. and B & B Builders Supplies, Inc., at Sherburne and Greene, respectively, produced sand and gravel.

Clinton.—Republic Steel Corp. mined magnetite at its Chateaugay mine near Dannemora (Lyon Mountain). The company agglomeration plant produced sinter, which was consumed for making pig iron and steel. A small quantity of concentrate was shipped to consumers. No ore was produced from the open-pit section of the mine. Exploration and development continued. Gneiss (miscellaneous stone) was recovered from tailings and sold as concrete aggregate, railroad ballast, and stone sand.

International Lime & Stone Corp. produced limestone near Chazy for use as riprap, blast-furnace and open-hearth flux, concrete aggregate, and agstone and for manufacturing lime at its nearby plant. Quicklime and hydrated lime were produced at the plant in two shaft kilns and a batch hydrator. Lime was marketed for agricultural, chemical, and industrial uses. Most of the output was consumed in New York; the remainder was shipped to New England States and Canada. Limestone also was quarried by Plattsburgh Quarries Inc. in Plattsburgh for concrete aggregate and roadstone. Bero Construction Corp. in Morrisonville produced mainly building and paving sand and gravel.

Columbia.—In terms of value, the county ranked second among the cement-producing counties. Portland and masonry cements were produced by Lone Star Cement Corp. in Greenport and Universal Atlas Cement Division of United States Steel Corp. in Hudson. Both companies used limestone and clays mined nearby as the principal cement raw materials. Finished cement was shipped chiefly to consumers in New York State and New England States. Limestone also was quarried by Catskill Mountain Stone Corp. at Hudson. Sand and gravel was recovered from pits near Claverack, Hillsdale, Hudson, and Livingston. Selenite crystals were recovered near Stockport by an amateur mineral collector.

Cortland.—Sand and gravel for building and highway construction and maintenance was produced by Cortland Ready Mix Concrete, Inc. in Cortland.

Delaware.—In terms of value, Delaware continued as the leading sandstone-producing county. Both crushed and dimension sandstone were produced. Cooney Bros., Inc., produced crushed sandstone for concrete aggregate and roadstone at a newly developed quarry near Hancock. Dimension sandstone (bluestone) was used for construction and architectural purposes, curbing, and flagging. Stone, quarried in Delaware and surrounding New York counties and in neighboring Pennsylvania counties, was dressed at processing yards in Delaware County. Bluestone fabricators were W. R. Strong & Son and Willis Hankins, both near Deposit, Johnston & Rhodes Bluestone Co. in East

Branch, Paul Thompkins Estate in Hancock, and American Bluestone Co. in Masonville. Output of sand and gravel was reported from Government-and-contractor operations.

Dutchess.—Dutchess County continued to rank first in value of commercial limestone, used chiefly for concrete aggregate and roadstone. Producers were New York Trap Rock Corp. in New Hamburg and Dutchess Quarry & Supply Co., Inc., in Pleasant Valley. White Marble Corp. in Wingdale was idle. Output of commercial sand and gravel totaled 502,000 tons—2 percent greater than in 1960. Production was reported from 11 operations and consisted chiefly of building and paving material. Clay and shale was mined from pits near Beacon by Dennings Point Brick Works, Inc., for use in manufacturing building brick.

Erie.—Lehigh Portland Cement Co. and Penn-Dixie Cement Corp. produced portland and masonry cements at Buffalo. The plants used limestone, shale, clay, gypsum, sand, iron ore, mill scale, and pyrite sinter as cement raw materials. Shipments of finished cement were made to consumers in New York and Pennsylvania. Commercial production of limestone increased and totaled 1.5 million tons. Limestone was produced by Buffalo Crushed Stone Corp. in Bowmansville, County Line Stone Co., Inc., in Akron, Federal Crushed Stone Corp. in Cheektowaga, and Lancaster Stone Products Corp. in Lancaster. The stone was crushed for agricultural purposes and for use as concrete aggregate and riprap.

Crude gypsum was recovered from underground mines near Clarence Center by Bestwall Gypsum Co., National Gypsum Co., and Universal Atlas Cement Co. Bestwall Gypsum Co. shipped crude gypsum to the company-owned plant at Akron, where the material was calcined and made into finished building products. Crude perlite from outside the State also was expanded at the Akron plant. National Gypsum Co., at Clarence Center, calcined crude gypsum and expanded crude perlite shipped from other States. Both materials were used for manufacturing finished building products. Universal Atlas shipped its gypsum output to company-owned plants for use as a portland-cement retarder. Crude perlite, shipped from Western States, was expanded at the Cheektowaga plant of Buffalo Perlite Corp. The expanded perlite was used as plaster and concrete aggregate, as well as for loose-fill insulation and soil conditioning, and for filter purposes.

Erie County continued to rank third in quantity and value of commercial sand and gravel. Ten producers were active with a combined total output of 1.3 million tons—slightly below the 1960 output. Most of the material was processed for building and paving purposes. Kelley Island New York Corp. produced metallurgical quicklime at its Buffalo plant. The County continued to rank first in output of clays. Clay was recovered from pits near Lakeview and West Falls and was used for manufacturing building brick. Anchor Concrete Products, Inc., produced lightweight aggregate by the rotary kiln process from clays mined at Jewettsville. Substantial quantities of clay were mined for use in manufacturing cement. A limited quantity was mined near Buffalo for producing flowerpots.

Essex.—Republic Steel Corp. produced magnetite from its Fisher

Hill and Old Bed-Harmony mines near Mineville. Ore from the Fisher Hill mine was treated at the company's No. 7 Concentrator, which also processed ore from the Old Bed-Harmony operation. Exploration and development continued at an active pace throughout the year. The sinter produced was consumed mostly in the manufacture of pig iron and steel. National Lead Co., Titanium Division, recovered magnetite from a titaniferous magnetite ore at its MacIntyre underground mine at Tahawas. This was the second largest mine in New York; its product was processed by heavy-medium separation, flotation, magnetic separation, and sintering and was used for manufacturing pig iron and steel, cement, and a heavy medium for mineral separation. Ilmenite also was recovered at Tahawas for use mostly in pigments.

Wollastonite and byproduct abrasive garnet (andradite) were mined underground by Cabot Minerals Division, Cabot Corp., at Willsboro. The wollastonite was processed for use as a filler in paints, ceramics, and plastics. Development of the underground mine was continued by raising and drifting. Adirondack Development Corp. continued exploratory drilling for wollastonite at the Deerhead mine near Lewis. The company conducted 1,500 feet of diamond drilling. International Paper Co. recovered quicklime for recycling and use in manufacturing paper at its Ticonderoga plant. Sand and gravel used mostly for road construction and maintenance was recovered from pits near Keesville, Saranac Lake, and Ticonderoga. Mineral specimens consisting of uraninite, uranophane, rosalite, and allanite were collected from unspecified locations in the county.

Franklin.—Adirondack Stone Quarries, Inc., in Malone and Franklin-Clinton Sandstone Co., Inc., in Burke produced dimension sandstone. The material was fabricated for use in construction and for architectural and flagging purposes. Commercial production of sand and gravel was reported from pits near Brushton, Malone, and Westville and totaled 82,000 tons compared with 114,000 tons in 1960.

Fulton.—Commercial output of sand and gravel was reported by 8 producers from operations near Broadalbin, Gloversville, Johnstown, Northampton, and St. Johnsville. Output totaled 107,000 tons and was used mainly for building and paving and as fill material. Quartz crystals were recovered near Fonda by a mineral collector.

Genesee.—Gypsum was recovered underground at Oakfield by United States Gypsum Co. General Crushed Stone Co. in North LeRoy, Genesee Stone Products Corp. in Stafford, and LeRoy Lime & Crushed Stone Corp. in LeRoy quarried and crushed limestone. Output was used as concrete aggregate, railroad ballast, agstone, and riprap. Sand and gravel used mainly as building material was produced by Batavia Washed Sand & Gravel Co., Inc., in Stafford, Frey Sand & Gravel Corp. in Alexander, and Western New York Gravel & Concrete Corp. in Batavia.

Greene.—The County continued to rank first in value of cement produced. Lehigh Portland Cement Co. and Marquette Cement Manufacturing Co. (formerly North American Cement Corp.), both near Alsen, and Alpha Portland Cement Co. in Catskill produced portland and masonry cements. Limestone recovered from nearby quarries was used as the main cement raw material. Marquette Cement Manufacturing Co. also mined clay. The companies also purchased gypsum, iron ore, pumice, and pyrite sinter for use as cement raw materials. Most of the finished cement was shipped to consumers in New York, New Jersey, and New England States. Limestone for aggregate was produced by Tri County Asphalt & Stone Co., Inc., at a newly developed quarry near Jewett. Catskill Mountain Stone Co., Inc., in Cairo, produced sandstone for concrete aggregate and riprap. Molding sand was produced by Whitehead Brothers Co. at Catskill and Coxsackie. Coxsackie Sand & Gravel Co., Inc., in Coxsackie produced sand for building, fill, and ice control and fill gravel.

Herkimer.—Limestone for aggregate, agstone, and asphalt filler was produced at the Jordanville quarry of General Crushed Stone Co. Material Sand & Gravel Corp. in Gravesville produced mainly building sand and paving gravel. Nash Sand Co. in Poland produced building sand. Quartz crystals used as mineral specimens were recovered near Middleville.

Jefferson.—General Crushed Stone Co. in Watertown produced limestone for concrete aggregate, agstone, asphalt filler, and railroad ballast. The highway departments of Cape Vincent and Lyme produced limestone for concrete aggregate and riprap. Multi-Color Sandstone Co. quarried stone for architectural uses at Alexandria. Sand and gravel output by commercial producers totaled 227,000 tons—4 percent less than in 1960. Five producers recovered sand and gravel from pits near Belleville, Gouverneur, and Watertown.

Lewis.—Carbola Chemical Co., Inc., in Natural Bridge produced limestone used at paper mills, as a filler in soap and insecticides, and as whiting. Limestone for concrete aggregate and roadstone was produced by the highway department of Lowville. Commercial production of sand and gravel was reported near Lowville.

Livingston.—Livingston continued as the State's leading salt-producing county. Rock salt, used mainly in manufacturing chemicals (principally chlorine) and for highway ice removal, was recovered from the Retsof underground mine of International Salt Co. Most of the salt was consumed in New York and other Northeastern States. General Crushed Stone Co. produced limestone for concrete aggregate and asphalt filler from its Rochester quarry near Honeoye Falls. Commercial sand and gravel, used principally for building purposes, was produced by The Valley Sand & Gravel Corp., in Avon and Wadsworth and Chester L. McMaster, Dansville.

Madison.—Munnsville Limestone Corp. in Munnsville, and Worlock Stone Co., Inc., in Perryville quarried and crushed limestone for concrete aggregate, agstone, and riprap.

Monroe.—Dolomite Products Co. operated quarries at Penfield and Gates and produced limestone used for concrete aggregate and agstone. Concrete Materials Inc. (formerly Central Materials Corp.) produced limestone for concrete aggregate at Brockport. Output of sand and gravel totaled 675,000 tons, compared with 1.1 million tons in 1960. Output consisting primarily of processed material for building and paving was recovered from pits near Mendon, Scottsville, Spencerport, Rochester, and Webster. Ruberoid Co. mined gypsum at Wheatland and shipped it to Caledonia for processing into finished gypsum building products.

Montgomery.—Crushed limestone for concrete aggregate was produced by Crushed Rock Products, Inc., in West Pattersonville and Cushing Stone Co., in Amsterdam. Commercial production of sand and gravel came from the St. Johnsville operation of St. Johnsville Supply Co., Inc. Most of the output was processed and sold as building material.

Nassau.—The county continued to rank second in tonnage and value of sand and gravel produced. Ouput totaled nearly 6 million tons, compared with 5.4 million tons in 1960. Production was reported from 8 operations and consisted entirely of processed material, which was transported to consumers by truck and barge. Clay for manufacturing building brick was produced by Nassau Brick Co., Inc., in Farmingdale.

Niagara.—Output of limestone for the Niagara Power project dropped sharply as construction neared completion. Production totaled 2.4 million tons compared with 5.5 million tons in 1960. Most of the crushed stone was used as concrete aggregate and as dike filter material. Limestone also was produced commercially by Niagara Stone Division, Olsker-McLain Industries, Inc., in Niagara Falls; Frontier Stone Products, Inc., in Lockport; and Royalton Stone Corp. in Gasport. Most of the output was sold for concrete aggregate and agstone, and for metallurgical purposes. Quicklime for manufacturing paper was recovered and recycled at the North Tonawanda plant of International Paper Co. Quicklime also was produced for use in manufacturing calcium carbide and for metallurgical purposes. Processed sand and gravel was produced by Gasport Sand & Gravel Co., Inc., in Lockport.

Oneida.—Eastern Rock Products, Inc., operated the Prospect No. 6 and Oriskany Falls No. 5 quarries and produced limestone used as concrete agregate, agstone, and riprap. Commercial output totaling 488,000 tons of sand and gravel was reported from 9 operations. Most of the output was processed and sold for use in the construction industry. Molding sand was recovered from pits near Camden and McConnellsville. Specimens of hematite were recovered by a mineral collector. Zonolite Co. produced exfoliated vermiculite at Utica from material shipped from mines in Montana and South Carolina.

Output of crude red iron oxide pigment (hematite) by Clinton Metallic Paint Co. was 11 percent less than in 1960. The material, used in paints, was obtained from the firm's Brimfield underground mine near Clinton. Vertical shafts were used for access and longwall (long face) mining was used to recover the ore.

Onondaga.—Solvay Process Division, Allied Chemical Corp., quarried limestone at Jamesville and operated salt wells at Tully. Part of the limestone output was sold for concrete aggregate and agstone; the remainder was consumed by the company at its Syracuse plant, where it was burned into quicklime and used for producing alkalies. The quicklime was combined with salt brine for manufacturing soda ash. Some of the salt brine was converted to evaporated salt in vacuum pans and sold for manufacturing chemicals. Limestone also was produced at the Rock Cut quarry of General Crushed Stone Co. at Jamesville. Alpha Portland Cement Co. in Jamesville produced portland and masonry cements. The company operated a shale mine nearby and purchased limestone (cement rock), sand, gypsum, and iron ore as cement raw materials. Most of the output was shipped by truck and in bulk form to consumers in New York and Pennsylvania.

Output of commercial sand and gravel totaled 935,000 tons, compared with 856,000 tons in 1960. Production was reported from 14 operations compared with 12 in 1960. Most of the output was processed and sold for building and highway construction and maintenance. Lightweight aggregate was produced by Onondaga Brick Corp. at Warners by sintering shale mined nearby. Syracuse Pottery Co., Inc., mined red clay for manufacturing pottery and flowerpots at Camillus. Expanded perlite was produced at Syracuse by Minerals Processing Corp. Crude material shipped from Colorado and Utah was processed for soil conditioning and plaster and concrete aggregate.

Ontario.—Limestone for concrete aggregate and railroad ballast was produced at the Oaks Corners quarry of General Crushed Stone Co. in Geneva. Output of sand and gravel by commercial producers totaled 545,000 tons, compared with 369,000 tons in 1960. Production was reported from pits near Clifton Springs, Geneva, Oaks Corners, and Victor.

Orange.—Compared with 1960, commercial output of sand and gravel decreased 19 percent and totaled 525,000 tons. Ninety-seven percent of the county output was processed material and came from eight operations. Clay for manufacturing building brick was mined near Roseton by Jova Brick Works. Dutchess Quarry & Supply Co., Inc., produced limestone for roadstone at Goshen. Sterling Forest Peat Co., Inc., produced reed-sedge peat from bogs near Tuxedo. Both packaged and bulk sales were made.

Orleans.—Clarendon Stone Co., Inc., in Clarendon quarried and crushed limestone for concrete aggregate, roadstone, and asphalt filler. Commercial production of sand and gravel decreased. It came from four operations, near Albion, Barre, Medina, and Shelby. The output was mostly processed material and was used mainly for building and as fill material.

Oswego.—Compared with 1960, output of commercial sand and gravel decreased. Mostly building and paving sand and gravel was recovered from pits near Lacona and Oswego. Molding sand was produced near Pulaski by Whitehead Bros. Co.

Otsego.—Barrett Division, Allied Chemical Corp., produced limestone for concrete aggregate and riprap from its Springfield quarry near Richifield Springs. Dimension sandstone (bluestone) was quarried near Oneonta. Seward Gravel Co. in Milford and Unadilla Concrete Products Co. in Unadilla produced sand and gravel mainly for building and paving.

Putnam.—Leemac Sand & Stone Corp. in Coldspring and Harlem Valley Crusher Co., Inc., in Patterson produced sand and gravel. Limestone, used as a mineral filler and as agstone, was quarried near Patterson by Patterson Mineral Corp. Specimens of hornblende and magnetite were collected from the Tillie Foster mine by a mineral collector.

Rensselaer.—Fitzgerald Bros. Construction Co., Inc., quarried stone for concrete aggregate and roadstone at its Campbell Mountain quarry. Output of sand and gravel increased and was recovered from pits located throughout the county. Albany Gravel Co., Inc., was the leading producer. Champlain Brick Co. resumed clay mining at its pit near Schaghticoke.

Richmond.—Calcined gypsum for manufacturing finished building products was produced at the New Brighton plant of United States Gypsum Co.

Rockland.—The county ranked third in value of stone production; it had ranked second in 1960. New York Trap Rock Co. produced limestone at Tompkins Cove and basalt trap rock at Haverstraw and West Nyack. Output from these quarries was sold as concrete aggregate, roadstone, stone sand, and riprap. Suffern Stone Co. in Suffern also quarried basalt for concrete aggregate. Output of sand and gravel totaled 793,000 tons, compared with 943,000 tons in 1960. Producers were Graney Building Material Corp. in Sparkill, Mount Ivy Sand & Gravel Co., Inc., in Congers, Ramapo Sand & Gravel Corp. in Hillburn, Ward Pavement, Inc., in Thiells, and Elinor Allison in Stony Point. United States Gypsum Co. calcined crude gypsum at its Stony Point plant.

St. Lawrence.—Jones and Laughlin Steel Corp. operated the largest iron-ore mine in New York near Star Lake. This open-pit mine was active the entire year and was mined on three benches. The concentrate and sinter produced were consumed mostly in making pig iron and steel. For the sinter plant, new crushing, screening, and cooling facilities, which were installed in the latter part of 1960, were in full and satisfactory use during the year. The cooler is a vertical-shaft stationary type, the first of its kind in the United States. The sinter is cooled by blasts of air as it works down through the vertical shaft. This shaft is similar in shape to a blast furnace; it is about 100 feet high, and 44 feet in diameter at its widest point. Rated capacity of the cooler was said to be 3,800 long tons of product a day.[4]

St. Joseph Lead Co. recovered zinc from the Edwards mine and zinc, lead, and silver from the Balmat mine, both near Gouverneur. Both mines worked steadily the entire year. Production was less than in 1960 because of overproduction and the reduced price of zinc. As a result, the workweek was reduced from 48 to 40 hours, effective February 27. Mining methods employed were 80 percent room and pillar and 20 percent casual or random pillars. Development proceeded satisfactorily at both mines. Exploration and development at the Edwards mine consisted of 1,997 feet of raising, 3,370 feet of drifting, and 5,419 feet of underground diamond drilling. Development at the Balmat mine consisted of 5,853 feet of raising, 8,723 feet of drifting, and 20,125 feet of underground diamond drilling. The new flotation circuit installed at the Balmat mill in 1960 continued to function efficiently. Zinc concentrate from each mine was shipped to Josephtown, Pa., for recovery of zinc at the company smelter. Lead concentrate from the Balmat mine and lead residue from the Josephtown smelter were shipped to the Herculaneum, Mo., smelter for recovery of lead and silver. A new 3-year labor contract was signed at midyear between St. Joseph Lead Co. and the United Steelworkers of America for the Balmat and Edwards mines.

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[4] Blast Furnace and Steel Plant. New Sinter Cooler in Operation. V. 49, No. 1, January 1961, p. 100.

International Talc Co., Inc., recovered crude talc from mines near Balmat and Edwards. Gouverneur Talc Co., Inc., mined talc from its underground mine at Balmat. Both companies operated crushing and grinding plants and sold ground talc for a variety of uses. Limestone used mainly for concrete aggregate was produced by Barrett Division, Allied Chemical Corp., in Norwood and McConville, Inc., in Ogdensburg. Marble for agstone and concrete aggregate was produced by Balducci Crushed Stone Co. at Gouverneur. Commercial production of sand and gravel totaled 11,000 tons—34 percent less than in 1960. Output was reported from pits near Nicholville, Potsdam, Rossie, Fine, and Canton.

Saratoga.—Output of commercial sand and gravel totaled 236,000 tons—a 35-percent increase over 1960. Production consisted primarily of processed paving, molding, and engine sand; 10 producers were active. Glens Falls Portland Cement Co., Division of The Flintkote Co., produced limestone at Glens Falls for its cement plant in Warren County. Pallette Stone Corp. in Saratoga Springs produced limestone for concrete aggregate, riprap, and agstone.

Schenectady.—Commercial sand and gravel production decreased and came from operations near Rotterdam, Schenectady, and Scotia. Most of the output was processed for building and paving.

Schoharie.—Marquette Cement Manufacturing Co. (formerly North American Cement Co.) produced portland and masonry cements at its Howes Cave plant. The company utilized limestone and shale mined nearby as the principal cement raw materials. In addition, the company also used sand, gypsum, and iron ore. New York and New England were the principal marketing areas for the finished cement. Limestone also was produced by Cobleskill Stone Products Division, Allied Materials Corp., in Cobleskill, and Masick Soil Conservation Co. and Schoharie Stone Corp, both near Schoharie.

Schuyler.—Evaporated salt was produced by International Salt Co., Inc., and Watkins Salt Co., Inc., both near Watkins Glen. The salt was used chiefly by the chemical industry; some was marketed in pressed blocks. New York, Pennsylvania, and New Jersey were the principal marketing areas for the evaporated salt; small quantities were exported. Commercial sand and gravel was recovered near Watkins Glen.

Seneca.—Finger Lakes Peat Moss Co. (formerly Finger Lakes Peat Moss & Junius Peat Co., Inc.) produced reed-sedge peat from bogs near Junius. All sales were in bulk. Sand for ice control and gravel for paving were produced by crews of the Seneca County Highway Department.

Steuben.—Output of commercial sand and gravel increased compared with 1960. Producers were Buffalo Slag Co., Inc., in Cohocton, Rhinehart Sand & Gravel, Inc., in Corning, Bath Sand & Gravel, Inc., in Bath, and Dalrymple Gravel & Construction Co., in Elmyra.

Suffolk.—Suffolk continued as the leading sand and gravel-producing county. Commercial output totaled 6.6 million tons compared with 5.6 million tons in 1960. Twenty-two operations were active; over 500,000 tons were recovered from each of four operations. Ninety-three percent of the commercial output was processed material, compared with 90 percent in 1960.

Sullivan.—Sullivan Highway Products Co. quarried sandstone at Bridgeville and Kenoza Lake. Output was used for concrete aggregate and stone sand. Sand and gravel was produced near Liberty, Masten Lake, Mongaup Valley, and Summitville.

The Shawangunk Minerals Co., Inc., River Vale, N.J., reactivated an old lead-zinc mine on the McDonald property near Wurtsboro. A total of about $1 million was to be spent on exploration, on reopening underground workings, and on a new mill. Ore bodies averaging 12 percent zinc, 5 percent lead, and 0.25 percent copper were reported. These deposits in the Wurtsboro Valley were first mined in 1830, then abandoned, subsequently reopened during the First World War, and later again abandoned. Workings consist of an 1,180-foot adit, four levels, and various stopes and crosscuts.[5]

Tioga.—Sand and gravel output totaled 320,000 tons—25 percent higher than in 1960. Producers were Concrete Materials, Inc. (formerly Central Materials Corp.) in Tioga; Herman E. Bunce in Barton, C. & C. Ready-Mix Corp. in Owego, and A. O. Swanson in Waverly.

Tompkins.—Rock salt was recovered underground near Myers by Cayuga Rock Salt Co., Inc., The bulk of the output was used for highway ice control in the Northeastern States. International Salt Co., Inc., produced evaporated salt at its Ludlowville refinery. The salt was recovered in vacuum pans and sold to a wide variety of consuming industries, mainly in New York and other Northeastern States. Cayuga Crushed Stone, Inc., produced limestone for concrete aggregate and riprap near South Lansing. Dimension sandstone (mainly architectural) was produced by Finger Lakes Stone Co., Inc., in Dryden. Sand and gravel was produced by Rumsey-Ithaca Corp. and University Sand & Gravel, both near Ithaca.

Ulster.—Hudson Cement Division, Colonial Sand & Stone Co., Inc., produced portland cement at Kingston. In addition to limestone (cement rock), quarried nearby, gypsum, mill scale, and pyrite sinter were used as cement raw materials. Natural and masonry cements were produced by Century Cement Manufacturing Co., Inc., at Rosendale. Limestone (cement rock) from a nearby underground mine was the principal cement raw material. Limestone was produced by Callanan Road Improvement Co. at its No. 3 plant near Esopus. Hurley Sand & Gravel Co., Inc., in Hurley and James J. Van Vliet & Son, Inc., in Marlboro produced sand and gravel mainly for building and paving. The Wawarsing plant of Dutchess Quarry & Supply Co., Inc., was idle during the year. Hutton Co. and Star Brick Corp., both near Kingston, mined miscellaneous clay for manufacturing building brick.

Warren.—Glens Falls Portland Cement Co., Division of The Flintkote Co., produced portland and masonry cements at Glens Falls. Limestone (cement rock) quarried in Saratoga County was the principal raw material. Sand, gypsum, and iron ore also were used. New York and New England were the principal marketing areas for the finished cement. Jointa Lime Co., Inc., produced limestone near Glens Falls. Warren Aggregates, Inc., quarried granite near Chestertown and produced building and paving sand. Bank run gravel was produced near Glens Falls. Barton Mines Corp. mined and processed abrasive garnet near North Creek. The refined garnet was used in manufacturing sandpaper and for grinding and polishing glass and metal lapping. Garnet used as mineral specimens was recovered near North Creek.

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[5] Mining World, v. 23, No. 10, September 1961, p. 62.

Washington.—The county continued as the center of the State slate industry. Twelve operations were active and were centered near Granville, Middle Granville, Whitehall, and Hampton. Most of the dimension slate was used as roofing and flagging material. Tri-County Asphalt & Stone Co., Inc., produced limestone near Kingsbury. Gravel was produced from pits near Eagle Bridge and Fort Ann.

Wayne.—General Crushed Stone Co. produced limestone near Sodus. Commercial sand and gravel was recovered from pits near Galen, Palmyra, and Red Creek.

Westchester.—Dimension granite was produced by DiRienzo Bros. and Baratta & D'Amato, both near Yonkers, and Lake Street Granite Quarry, Inc., in White Plains. The stone was sold for construction work and as curbing. Universal Marble Products Corp. in Thornwood produced dolomitic marble mainly for terrazzo, cast stone, stucco and agstone. Sand and gravel was recovered at three operations. Emery was recovered from the DeLuca No. 1 (Peekskill) and the Deluca No. 2 (Croton) mines of DeLuca Emery Mines and the Kingston mine of DiRubbo & Ellis near Croton. Colbate Emery Co. in Peekskill operated the Kingston mine for DiRubbo & Ellis. Output from the mine was shipped to plants in Massachusetts for general abrasive purposes. Output from both DeLuca mines was shipped to a plant at Peekskill for use as aggregate in heavy duty, nonslip floors.

Bulk sales of humus peat were made by Stone Age Humus Corp. Output came from bogs near Armonk. Small quantities of beryl were recovered by Richard Mullare at the Kinkel quarry near Bedford, an old feldspar operation, long inactive. The ore concentrate averaged 11.84 beryllium oxide, and sales were effected through the General Services Administration.

Wyoming.—Evaporated salt was produced by the vacuum-pan process at the Silver Springs plant of Morton Salt Co. American Bluestone Co. produced sandstone (bluestone) at its Ambluco quarry near Portageville.

The Mineral Industry of North Carolina

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of North Carolina.

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MINERAL PRODUCTION for North Carolina in 1961 set a new record of $50 million, over $5 million more than the previous peak year of 1960. In order of value, stone, sand and gravel, copper, mica, tungsten, feldspar, and clays were the principal minerals mined. North Carolina was first in the Nation in producing lithium minerals, feldspar, crushed granite, and sheet and scrap mica; second in olivine and tungsten; and third in talc and pyrophyllite combined.

TABLE 1.—Mineral production in North Carolina[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasive stones (millstones)	(2)	$2	(2)	$3
Clays[3] .... thousand short tons	2,476	1,548	2,603	1,669
Feldspar .... thousand long tons	271	2,781	252	2,477
Gem stones	(2)	4	(2)	6
Gold (recoverable content of ores, etc.) .... troy ounces	1,826	64	2,094	73
Iron ore (usable) .... long tons, gross weight	(4)	(4)	337	1
Lead (recoverable content of ores, etc.) .... short tons	424	99	318	66
Mica:				
Scrap .... thousand short tons	47	1,100	54	1,010
Sheet .... pounds	430,193	[5] 1,539	390,870	2,237
Sand and gravel .... thousand short tons	8,801	7,453	9,779	8,467
Silver (recoverable content of ores, etc.) .... troy ounces	212,368	192	169,742	157
Stone .... thousand short tons	14,721	23,296	15,921	25,262
Talc and pyrophyllite .... do	101	549	90	367
Values of items that cannot be disclosed: Asbestos, barite (1961), copper, kaolin, olivine, lithium minerals, tungsten, and values indicated by footnote 4	....	6,469	....	8,329
Total North Carolina	....	[5] 45,096	....	50,124

[1] Production is measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Excludes kaolin, included with "Value of items that cannot be disclosed."
[4] Figure withheld to avoid disclosing individual company confidential data.
[5] Revised figure.

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Metals accounted for 14 percent of the total value. Copper output increased 14 percent in tonnage and 7 percent in value; tungsten production was up more than 75 percent as Tungsten Mining Co. operated its mine and mill continuously in 1961, its first full year of active production since 1957. Byproduct lead, gold, and silver also were recovered in considerable quantities.

Lithium production was higher than in 1960. Stone output increased in tonnage and value, and that of sand and gravel was up 11 percent in tonnage and 14 percent in value. Scrap mica increased in tonnage but decreased in value, while sheet mica decreased in quantity and increased in value. Feldspar decreased in tonnage and value, and talc and pyrophyllite declined in tonnage and value for the second successive year.

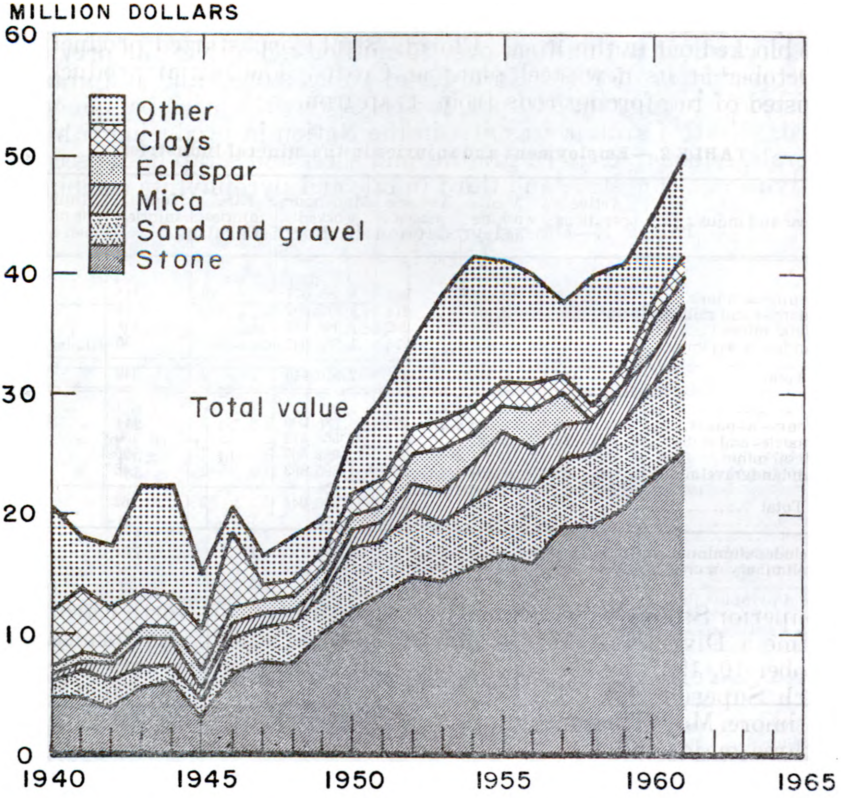

Figure 1.—Value of stone, sand and gravel, mica, feldspar, clays, and total value of mineral production in North Carolina, 1940–61.

Employment and Injuries.—Table 2 shows that there were 10 less operations and 140 less men working daily in 1961 than in 1960. However, sand and gravel mines increased by 3, and the number of men working in them daily increased by 42. The total man-hours worked in all operations was down 6 percent; the largest decrease was in metal mines, in which total man-hours were 20 percent below 1960.

Injury experience was higher than in 1960; 3 fatalities were recorded in 1961, compared with only 2 in 1960; nonfatal injuries totaled 362 against 349. Injuries per million man-hours were higher in all categories.

Trends and Developments.—Much interest was taken in the phosphorite deposits in the Pamlico river area of Beaufort County. Several large companies were leasing property in the region. The phosphorites, buried beneath strata ranging in thickness from 45 to 250 feet, underlie an area of over 450 square miles. The total thickness of the phosphorite column throughout the area ranges from several feet to nearly 90 feet.

Ideal Cement Co. started construction of a 1.5-million-barrel-per-year cement plant at Castle Hayne to process limestone from a deposit at Maple Hill, Pender County. Thirty-five million tons of limestone were blocked out in this area. Florida Steel Corp. started production in October at its new steel plant at Croft. The initial production consisted of reinforcing rods from scrap iron.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operations	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:							
Nonmetal mines	199	2, 566	261	5, 083, 075	2	115	23
Quarries and mills	86	2, 109	214	3, 612, 592	----------	94	26
Metal mines [1]	7	1, 013	292	2, 364, 186	----------	104	44
Sandandgravelmines	125	859	226	1, 555, 587	----------	36	23
Total	417	6, 547	241	12, 615, 440	2	349	28
1961: [2]							
Nonmetal mines	190	2. 588	226	4, 685, 200	1	111	24
Quarries and mills	83	2, 097	212	3, 563, 312	----------	100	28
Metal mines [1]	6	821	299	1, 962, 569	1	105	54
Sandandgravelmines	128	901	235	1, 695, 863	1	46	28
Total	407	6, 407	232	11, 906, 944	3	362	31

[1] Includes aluminum smelters.
[2] Preliminary figures.

Superior Stone Co., which had over 30 operations in North Carolina, became a Division of Martin-Marietta Corp., which was formed on October 10, 1961, by the consolidation of American-Marietta Co. (of which Superior Stone Co. was a Division) and The Martin Co. of Baltimore, Md. The consolidation created a well-diversified enterprise in three major industrial categories—construction materials, chemicals, and aerospace—with a sound balance between defense and nondefense activities.

Foote Mineral Co. began moving its Cold River, N.H., grinding mill to Kings Mountain, N.C. Petalite imported from Africa and domestically produced spodumene were to be processed for ceramic uses.

Legislation and Government Programs.—The Government Mica Purchasing Depot under the General Services Administration (GSA) at Spruce Pine operated throughout the year, purchasing 75,436 pounds of trimmed mica and 1,248,264 pounds of hand-cobbed mica for which

$2,160,388 was paid. The Domestic Mica Purchase Program was to terminate on June 30, 1962, or at such time as the program quantity limitation of 25,000 short tons of hand-cobbed (crude) mica or its equivalent in trimmed mica is acquired (90 pounds of trimmed mica equals 1 short ton of hand-cobbed mica). No Office of Mineral Exploration (OME) contracts were in force in 1961.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Millstones were produced in Rowan County; no grinding pebbles or tubemill liners were reported in 1961.

Asbestos.—Powhatan Mining Co. mined amphibole asbestos near Burnsville in Yancey County. Production was slightly less than in 1960.

Barite.—Bar-Tex Inc. mined a small quantity of barite at Stackhouse in Madison County.

Clays.—Total clay production increased 5 percent in tonnage and 7 percent in value over 1960. Kaolin increased 11 percent in tonnage and 4 percent in value, while miscellaneous clay increased 5 percent in tonnage and 8 percent in value. Harris Clay Co. in Avery County, operating two mines, was the only kaolin producer. Miscellaneous clay was mined by 30 companies from 35 pits in 20 counties for manufacturing lightweight aggregate, brick, tile, and other clay products. Principal producers were Solite Corp., Sanford Brick & Tile Co., Inc., Boren Clay Products Co., Pine Hall Brick & Pipe Co., and Mt. Gilead Brick Co.

Feldspar.—The production of crude feldspar, including flotation concentrates, decreased 7 percent from that produced in 1960, and the value fell 11 percent. The unit value dropped from $10.27 per long ton in 1960 to $9.83. Flotation concentrates made up over 95 percent of the total crude production. International Minerals and Chemical Corp. (Kona and Spruce Pine plants), The Feldspar Corp. (Spruce Pine and Burnsville plants), and Lawson-United Feldspar & Minerals Co. (Minpro plant) mined alaskite and recovered feldspar concentrates in Mitchell and Yancey Counties. Foote Mineral Co. recovered byproduct feldspar at its lithium plant in Cleveland County. Crude lump feldspar from Mitchell, Swain, Yancey, and other counties made up the balance of the production.

Sales of ground feldspar (including flotation concentrates) were 267,000 short tons valued at $2,769,000, a decrease of 3 percent in tonnage and 11 percent in value. The quantity of ground feldspar for glass uses changed little, but the value decreased 16 percent. Pottery and enamel uses declined considerably in both tonnage and value.

Gem Stones.—Gem stones and gem material having an estimated value of $6,000 were collected in 22 counties in 1961. Among the minerals reported were rutile, topaz, smoky quartz, sapphire, malachite, moonstone, amethyst, rhodolite garnet, beryl, hyalite opal, emerald, and ruby.

Lithium.—Foote Mineral Co. mined and processed spodumene at Kings Mountain, and Lithium Corporation of America converted spodumene to lithium chemicals at Bessemer City. Spodumene production increased 82 percent in tonnage and 26 percent in value.

Mica.—Sheet mica was down 9 percent in quantity and up 45 percent in value, and scrap increased 13 percent in tonnage but declined 8 percent in total value. Production of mica was reported from 132 mines in 12 counties, compared with 142 mines in 13 counties in 1960. A considerable tonnage could not be identified by county or mine of origin. Mitchell County, with 54 mines, accounted for 66 percent of the total value of mica production; Avery, Cleveland, Macon, and Yancey Counties accounted for 33 percent; and 7 other counties accounted for the remaining 1 percent. Leading producers of sheet mica were P&H Mining Co. (Gudger mine), McBee Mining Co. (McBee mine), Mountain Mining Co. (Jimmy Cut mine), Sink Hole Miners (Sink Hole mine), Abernathy Mining Co. (Abernathy mine), and Roy H. Fouts (Allman Cove mine). Principal scrap producers were Deneen Mica Co., Harris Clay Co., Kings Mountain Mica Co., Inc., Southern Mica Corp. of N.C., Feldspar Corp., and International Minerals & Chemical Corp. Output of ground mica was 21 percent higher, and the value increased 10 percent over 1960; 12 mica grinders were active during the year.

Olivine.—Olivine production increased 56 percent in tonnage and 77 percent in value. Mines were operated in Jackson County by Harbison-Walker Refractories Co. and Balsam Gap Co. and in Yancey County by Wiseman Mining Co., Inc., and Georgia Talc Co.

TABLE 3.—Sheet mica sold or used by producers, by counties

County	1960		1961	
	Pounds	Value	Pounds	Value
Avery	5,773	$73,822	2,790	$34,436
Cleveland	(1)	(1)	88	875
Jackson	1,480	10,670	73	1,359
Macon	14,887	112,198	18,748	222,422
Mitchell	110,135	1,200,653	212,242	1,859,716
Stokes	(1)	(1)	1,813	12,107
Yancey	15,734	87,621	9,174	81,906
Undistributed	282,184	53,960	145,942	24,218
Total	430,193	[2]1,538,924	390,870	2,237,034

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[2] Revised figure.

TABLE 4.—Mica sold or used by producers, by kinds

Kind	1960		1961	
	Quantity	Value	Quantity	Value
Sheet mica:				
Uncut punch and circle pounds	322,588	$20,923	247,959	$20,835
Larger uncut mica do	7,209	4,431	1,529	1,142
Full-trim purchased by GSA do	[1] 100,396	[1][2]1,513,570	141,382	2,215,057
Total sheet mica do	430,193	[2] 1,538,924	390,870	2,237,034
Scrap mica: short tons	47,281	1,099,502	53,615	1,010,389
Grand total (sheet and scrap) do	47,496	[2] 2,638,426	53,810	3,247,423

[1] Includes full-trimmed mica equivalent of hand-cobbed mica.
[2] Revised figure.

TABLE 5.—Ground mica sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Roofing	18,135	$470,312	$25.93	(1)	(1)	(1)
Well drilling	(1)	(1)	(1)	11.280	$306,881	$27.21
Paint	6,022	834,451	138.57	5,714	763.098	133.55
Rubber	3,362	407,450	121.19	3,290	404,309	122.89
Plastics	(1)	(1)	(1)	149	19,658	131.93
Wallpaper	192	24,155	125.81	202	23,948	118.55
Other uses [2]	13,180	482,237	36.59	28.640	914.018	31.91
Total	40,891	2,218,605	54.26	49,275	2,431,912	49.35

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other uses."
[2] Includes joint cement, welding rods, miscellaneous uses, and uses indicated by footnote 1.

Perlite.—Carolina Perlite Co., Inc., expanded perlite at Gold Hill from crude material shipped into North Carolina from Colorado. Quantity and value were about the same as in 1960.

Sand and Gravel.—Sand and gravel ranked second as a commodity in the State in both tonnage and value of production. Commercial sand and gravel supplied 65 percent of the tonnage and 75 percent of the value, compared with 68 and 80 percent, respectively, in 1960. Commercial sand increased 17 percent in tonnage and 21 percent in value, and Government-and-contractor sand increased 14 percent in tonnage and 19 percent in value. Commercial gravel was down 5 percent in tonnage but was up 1 percent in value. However, Government-and-contractor gravel increased 78 and 101 percent in tonnage and value, respectively. Sand and gravel was produced in 84 counties. Commercial sand and gravel was produced in 15 counties; gravel only was produced in 5 counties; and sand only was produced in 15 counties. Forty-two companies operated 51 pits in 33 counties, compared with 51 pits in 31 counties in 1960. Government-and-contractor output of sand only came from 67 counties, and sand and gravel, from 7 others. Leading producers were McCrary Construction Service, Becker County Sand and Gravel Co., lessees of B. V. Hedrick Gravel & Sand Co., and the State highway department.

Stone.—Output of stone, the principal mineral product of the State, increased 8 percent both in tonnage and value. Crushed stone production was up 10 percent in tonnage and 10 percent in value, whereas dimension stone decreased 3 percent in quantity and total value.

Crushed traprock production increased 56 percent in tonnage and value, crushed granite increased 4 percent in tonnage and 7 percent in value; and crushed marble more than doubled in both tonnage and value, while crushed sandstone decreased 16 percent in tonnage and 45 percent in value. Crushed limestone also was lower than in 1960. Production of dimension slate was unchanged from 1960, while dimension marble decreased 33 percent in quantity and 20 percent in value, and dimension granite decreased 2 percent and 1 percent, respectively, in quantity and value. Byproduct quartz was recovered from feldspar flotation plants in Mitchell County.

TABLE 6.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Alexander	47,090	$15,812	44,500	$14,685
Anson	1,706,590	1,859,027	(1)	(1)
Ashe	50,000	40,000	(1)	(1)
Avery	(1)	(1)	80,418	74,781
Beaufort	(1)	(1)	(1)	(1)
Bertie	1,620	486	3,000	875
Bladen	108,500	59,675	128.000	74,960
Brunswick	15,000	4,500	21,000	11,340
Buncombe	745,884	802,365	715,842	767,084
Burke	165,620	130,143	35,600	21,675
Cabarrus	----------	----------	105,520	107,458
Caldwell	123,837	125,589	(1)	(1)
Camden	3,000	900	6,000	3,240
Carteret	3,000	1,440	4,000	1,960
Caswell	41,900	41,900	20,500	20,500
Catawba	53,423	17,904	63,810	22,003
Cherokee	----------	----------	22,725	27,900
Chowan	2,800	840	2,400	720
Clay	36.489	25,626	----------	----------
Cleveland	(1)	(1)	(1)	(1)
Columbus	82,000	45,100	107,000	62,980
Craven	(1)	(1)	(1)	(1)
Cumberland	(1)	(1)	(1)	(1)
Currituck	17,500	5,250	58,300	22,770
Dare	77,500	23,250	4.640	2,506
Davidson	195,200	97,600	205,000	102,500
Davie	95,000	57,000	70,000	42,000
Duplin	8,150	2,525	10,225	5,587
Edgecombe	42,290	41.636	26,200	17,400
Forsyth	107,824	65,090	110,000	66,000
Franklin	4,000	2,000	9.800	4.700
Gaston	32.400	12,960	43,104	17.241
Gates	5,500	1,650	12.500	6,750
Granville	10,100	6,060	7,070	5,302
Greene	52,000	24,960	87,300	42,777
Guilford	6,000	6,000	5 750	5,750
Halifax	1.200	660	8,400	4,536
Harnett	(1)	(1)	(1)	(1)
Haywood	(1)	(1)	(1)	(1)
Hertford	21,996	6,598	77,460	39,707
Hoke	(1)	(1)	65,112	42,760
Hyde	1,500	450	1,800	540
Iredell	(1)	(1)	(1)	(1)
Johnston	34,235	31,835	68,271	80,421
Jones	(1)	(1)	19,668	10,576
Lee	58,340	32,087	85,644	46,248
Lenoir	(1)	(1)	(1)	(1)
Lincoln	27,050	10,820	45,330	18,132
Macon	4,050	3,000	----------	----------
Madison	2,000	2,000	5,000	3,500
Martin	3,700	1,110	1,800	540
McDowell	(1)	(1)	(1)	(1)
Mecklenburg	----------	----------	(1)	(1)
Montgomery	75,000	26,250	96,870	41,000
Moore	254,931	152,456	390,081	304,993
New Hanover	11,800	7,600	11,089	5,824
Northampton	(1)	(1)	(1)	(1)
Onslow	6,000	1,800	9,000	4,860
Pamlico	4,000	1,920	3,000	1,470
Pasquotank	15,000	4,500	15,000	8,100
Pender	6,000	1,800	9,000	4,860
Perquimans	17,500	5,250	4.000	2,160
Person	4,930	3,697	5,800	4,350
Pitt	(1)	(1)	128,460	77,897
Polk	----------	----------	76,000	41,700
Richmond	25,000	13,250	55,000	20,200
Robeson	161,000	88,550	169,000	97,180
Rockingham	2,859	2,859	2,527	2,527
Rowan	40,500	20,250	65,000	32,500
Rutherford	204,482	172,692	(1)	(1)
Sampson	10,000	3,000	15,000	8,100
Scotland	----------	----------	13,000	4,550
Stanly	----------	----------	55,735	82,102
Stokes	140,000	84,000	106,000	63,600
Surry	15,805	8,693	18,715	10,100
Transylvania	1,180	1,315	486	460
Tyrell	----------	----------	1,800	540

See footnote at end of table.

TABLE 6.—Sand and gravel sold or used by producers, by counties—Continued

County	1960		1961	
	Short tons	Value	Short tons	Value
Union	12,500	$9,375	8,000	$6,000
Vance	2,000	1,000	------	------
Wake	3,100	1,610	3,500	2,100
Washington	11,000	3,300	3,400	1,020
Watauga	(1)	(1)	(1)	(1)
Wayne	(1)	(1)	96,623	63,370
Wilkes	12,475	6,861	(1)	(1)
Wilson	61,377	56,455	54,336	34,925
Yadkin	29,775	16,376	11,445	17,167
Yancey	(1)	(1)	(1)	(1)
Undistributed	3,678,175	3,152,597	5,962,469	5,723,165
Total	8,800,677	7,453,304	9,779,025	8,467,224

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

TABLE 7.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Paving	2,818,986	$1,519,476	$0.54	3,457,169	$2,058,076	$0.60
Structural	2,247,311	1,599,621	.71	2,080,843	1,501,197	.72
Fill	19,943	12,375	.62	384,823	239,350	.62
Other [1]	73,476	55,912	.76	32,469	28,351	.87
Gravel:						
Paving	2,094,226	2,079,887	.99	2,098,989	2,018,907	.96
Structural	1,301,160	1,799,605	1.38	1,304,530	1,959,837	1.50
Fill	4,606	4,309	.94	1,838	1,838	1.00
Other [2]	240,969	382,119	1.59	418,364	659,668	1.58
Total sand and gravel	8,800,677	7,453,304	.85	9,779,025	8,467,224	.87

[1] Includes railroad ballast sand.
[2] Includes railroad ballast gravel.

Stone was quarried in 41 counties—granite in 26, limestone in 7, marble in 1 (Cherokee), quartz in 1 (Mitchell), slate in 2 (Davidson and Montgomery), and traprock in 12. Commercial stone, excluding quartz, was produced by 25 operators from 68 quarries—48 granite, 7 limestone, 2 slate, 10 traprock, and 1 marble. The State highway department crushed stone from 9 granite, 1 limestone, and 5 traprock quarries. Leading crushed stone producers were W. E. Graham & Sons, a division of Vulcan Materials Co. (granite); Superior Stone Co., a division of Martin-Marietta Corp. (granite, limestone, and traprock); and Nello L. Teer Co. (granite and traprock). Principal producers of dimension stone were North Carolina Granite Corp., Harris Granite Quarries, and Columbia Marble Co.

Talc and Pyrophyllite.—Combined production of crude talc and pyrophyllite decreased 10 percent in tonnage and 33 percent in value, showing a decline in both for the second straight year. Ground talc and pyrophyllite decreased 15 percent in tonnage and 16 percent in value. Sawed talc (crayons) decreased 16 percent in tonnage, but total value remained the same. Ground talc was sold principally for textile use and toilet preparations. Ground pyrophyllite was used principally in ceramics, insecticides, refractory, and rubber. Talc was mined in Cherokee County, and pyrophyllite was mined in Alamance, Moore, and Orange Counties.

TABLE 8.—Crushed granite sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Alamance	(1)	(1)	(1)	(1)
Bladen	3,500	$8,750	----------	----------
Buncombe	(1)	(1)	6,210	$12,400
Cabarrus	99,204	121,392	59,760	59,760
Caswell	348,977	546,424	(1)	(1)
Catawba	(1)	(1)	(1)	(1)
Cherokee	(1)	(1)	13,400	33,600
Columbus	4,700	11,750	----------	----------
Cumberland	2,900	7,250	----------	----------
Edgecombe	----------	----------	(1)	(1)
Forsyth	1,921,150	2,268,980	(1)	(1)
Gaston	(1)	(1)	(1)	(1)
Guilford	(1)	(1)	(1)	(1)
Harnett	20.500	51,250	----------	----------
Henderson	(1)	(1)	----------	----------
Iredell	(1)	(1)	(1)	(1)
Jackson	(1)	(1)	(1)	(1)
Lincoln	63,215	88,500	(1)	(1)
Macon	(1)	(1)	----------	----------
Mecklenburg	(1)	(1)	(1)	(1)
Orange	21,281	31,921	33,458	50.187
Pitt	----------	----------	(1)	(1)
Randolph	165,720	264,657	172,312	266,786
Robeson	4,000	10,000	----------	----------
Rockingham	(1)	(1)	(1)	(1)
Rowan	(1)	(1)	(1)	(1)
Surry	(1)	(1)	(1)	(1)
Swain	(1)	(1)	(1)	(1)
Transylvania	(1)	(1)	120,000	150,000
Vance	643.600	856,000	(1)	(1)
Wake	(1)	(1)	(1)	(1)
Wilkes	271,500	253,000	----------	----------
Wilson	(1)	(1)	(1)	(1)
Yadkin	239,000	370,000	(1)	(1)
Undistributed	6,911,005	10,384,439	10,792.832	15,814,030
Total	10,720,252	15.274,313	11,197,972	16,386,763

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Vermiculite.—Zonolite Co. operated an exfoliating plant at High Point, using crude vermiculite shipped into the State.

METALS

Gold, Silver, Copper, and Lead.—Copper production increased 14 percent in tonnage and 7 percent in value. Appalachian Sulphides, Inc., mined and concentrated sulfide ore from the Ore Knob mine at West Jefferson, and Tungsten Mining Corp. recovered copper and lead by flotation of tailings from its tungsten mill in Vance County. Gold and silver were recovered from the smelting of concentrates of both companies. Small quantities of gold and silver also were reported by operators in Cherokee and Montgomery Counties. Appalachian Sulphides, Inc., reported a reserve of 154,000 tons of ore as of December 31, 1961, or sufficient to continue operating until about July 1962.

Iron Ore.—Cranberry Magnetite Corp. shipped a small tonnage of magnetite from its Cranberry mine to steel mills in Alabama.

Silicon.—High-purity silicon was produced by E. I. du Pont de Nemours & Co., Inc., at Brevard.

Tungsten.—The Hamme mine and mill of Tungsten Mining Corp. near Henderson in Vance County was in operation the entire year.

REVIEW BY COUNTIES

Ninety-six of the 100 counties in North Carolina reported mineral production; Mitchell, Vance, Cleveland, Ashe, and Guilford were the leading counties. In addition to the detailed county production listed in table 9, considerable quantities of crude feldspar, sheet mica, and scrap mica—all of undetermined county origin—were produced.

Alamance.—Superior Stone Co., a division of Martin-Marietta Corp. (Burlington and Mebane quarries), and North Carolina State Highway and Public Works Commission (Bason quarry) crushed granite for concrete and roads. Boren & Harvey, Inc., mined pyrophyllite for refractory and ceramic uses at the Snow Camp mine. Hanford Brick Co., Inc. (Hanford mine), mined miscellaneous clay for heavy clay products.

Alexander.—The State highway commission mined paving sand. Harley Hines and Ruth Stanley collected gem stones (white topaz, sherry topaz, smoky quartz, white sapphire, and rutile).

Allegheny.—Ararat Products Co. crushed traprock for concrete and roads at the Allegheny quarry.

Anson.—Lessees of B. V. Hedrick Gravel & Sand Co. (Lilesville mine), W. R. Bonsal Co., Inc. (Bonsal mine), and the State highway commission mined sand and gravel for structural, paving, railroad ballast, and miscellaneous uses. The State highway commission crushed traprock for concrete and roads at the Sugartown and Hendley quarries.

TABLE 9.—Value of mineral production in North Carolina, by counties [1]

County	1960	1961	Minerals produced in 1961 in order of value
Alamance	(2)	(2)	Granite, pyrophyllite, miscellaneous clay.
Alexander	$18,417	$16,795	Sand and gravel, gem stones.
Alleghany	(2)	(2)	Traprock.
Anson	1,887,129	(2)	Sand and gravel, traprock.
Ashe	(2)	(2)	Copper, gold, sand and gravel, silver, gem stones, mica.
Avery	(2)	(2)	Kaolin, mica, sand and gravel, iron ore, gem stones.
Beaufort	(2)	(2)	Sand and gravel.
Bertie	468	875	Do.
Bladen	68,425	74,960	Do.
Brunswick	4,500	11,340	Do.
Buncombe	(2)	779,484	Sand and gravel, granite.
Burke	130,693	21,785	Sand and gravel, gem stones.
Cabarrus	121,392	(2)	Sand and gravel, granite, traprock, gem stones.
Caldwell	125,589	(2)	Sand and gravel.
Camden	900	3,240	Do.
Carteret	1,440	1,960	Do.
Caswell	588,324	(2)	Granite, sand and gravel, gem stones.
Catawba	(2)	(2)	Granite, miscellaneous clay, sand and gravel, mica, gem stones.
Chatham	340,531	371,996	Miscellaneous clay, traprock.
Cherokee	(2)	(2)	Marble, granite, sand and gravel, talc, gold, silver.
Chowan	840	720	Sand and gravel.
Clay	25,626	------------	
Cleveland	(2)	(2)	Limestone, lithium minerals, traprock, mica, sand and gravel, feldspar, miscellaneous clay.
Columbus	56,850	62,980	Sand and gravel.
Craven	(2)	(2)	Limestone, sand and gravel.
Cumberland	(2)	(2)	Sand and gravel, miscellaneous clay.
Currituck	5,250	22,770	Sand and gravel.
Dare	23,250	2,506	Do.

See footnotes at end of table.

TABLE 9.—Value of mineral production in North Carolina, by counties—Con.

County	1960	1961	Minerals produced in 1961 in order of value
Davidson	(2)	(2)	Traprock, sand and gravel, slate, miscellaneous clay.
Davie	$57,005	$42,000	Sand and gravel.
Duplin	2,525	5,587	Do.
Durham	(2)	(2)	Traprock, miscellaneous clay, gem stones.
Edgecombe	41,636	(2)	Granite, sand and gravel.
Forsyth	2,334,070	(2)	Granite, sand and gravel, gem stones.
Franklin	2,000	4,700	Sand and gravel.
Gaston	(2)	(2)	Granite, sand and gravel, miscellaneous clay.
Gates	1,650	6,750	Sand and gravel.
Granville	6,135	5,522	Sand and gravel, gem stones.
Greene	24,960	42,777	Sand and gravel.
Guilford	(2)	(2)	Granite, traprock, miscellaneous clay, sand and gravel.
Halifax	(2)	(2)	Miscellaneous clay, sand and gravel.
Harnett	(2)	(2)	Sand and gravel, miscellaneous clay.
Haywood	(2)	(2)	Sand and gravel.
Henderson	(2)	(2)	Limestone, miscellaneous clay.
Hertford	6,598	39,707	Sand and gravel.
Hoke	(2)	42,760	Do.
Hyde	450	540	Do.
Iredell	(2)	(2)	Granite, sand and gravel.
Jackson	(2)	(2)	Olivine, granite, mica.
Johnston	(2)	(2)	Traprock, sand and gravel, gem stones.
Jones	(2)	10,576	Sand and gravel.
Lee	312,369	(2)	Miscellaneous clay, sand and gravel.
Lenoir	(2)	(2)	Sand and gravel.
Lincoln	99,702	(2)	Granite, sand and gravel, gem stones, mica.
Macon	(2)	296,471	Mica, gem stones.
Madison	2,000	(2)	Sand and gravel, barite.
Martin	1,110	540	Sand and gravel.
McDowell	(2)	(2)	Sand and gravel, limestone.
Mecklenburg	(2)	(2)	Granite, sand and gravel.
Mitchell	(2)	(2)	Feldspar, mica, sandstone, gem stones.
Montgomery	(2)	(2)	Miscellaneous clay, sand and gravel, slate, gold, silver.
Moore	(2)	(2)	Sand and gravel, pyrophyllite, miscellaneous clay, gem stones.
New Hanover	34,582	5,824	Sand and gravel.
Northampton	(2)	(2)	Do.
Onslow	(2)	(2)	Limestone, sand and gravel.
Orange	(2)	(2)	Traprock, granite, pyrophyllite.
Pamlico	1,920	1,470	Sand and gravel.
Pasquotank	4,500	8,100	Do.
Pender	1,800	4,860	Do.
Perquimans	5,250	2,160	Do.
Person	3,698	4,400	Sand and gravel, gem stones.
Pitt	(2)	(2)	Sand and gravel, granite.
Polk	----------	41,700	Sand and gravel.
Randolph	(2)	266,786	Granite.
Richmond	13,250	20,200	Sand and gravel.
Robeson	98,550	97,180	Do.
Rockingham	(2)	(2)	Granite, miscellaneous clay, traprock, sand and gravel.
Rowan	1,958,684	(2)	Granite, miscellaneous clay, sand and gravel, millstones.
Rutherford	172,742	(2)	Sand and gravel, mica.
Sampson	18,936	(2)	Miscellaneous clay, sand and gravel.
Scotland	----------	4,550	Sand and gravel.
Stanly	312,506	389,604	Miscellaneous clay, sand and gravel, traprock.
Stokes	(2)	(2)	Miscellaneous clay, sand and gravel, mica, gem stones.
Surry	(2)	(2)	Granite, sand and gravel, gem stones.
Swain	(2)	(2)	Limestone, granite, feldspar.
Transylvania	(2)	154,333	Granite, mica, sand and gravel.
Tyrrell	----------	540	Sand and gravel.
Union	(2)	(2)	Traprock, miscellaneous clay, sand and gravel.
Vance	(2)	(2)	Tungsten, granite, silver, lead, copper, gold.
Wake	(2)	(2)	Granite, sand and gravel, gem stones.
Washington	3,300	1,020	Sand and gravel.
Watauga	(2)	(2)	Sand and gravel, gem stones.
Wayne	(2)	63,380	Do.
Wilkes	260,029	(2)	Do.
Wilson	(2)	(2)	Granite, sand and gravel.
Yadkin	408,146	(2)	Granite, limestone, sand and gravel.
Yancey	(2)	(2)	Mica, sand and gravel, olivine, asbestos.
Undistributed	[3]35,506,256	47,188,552	
Total	[3]45,096,000	50,124,000	

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[1] Graham, Nash, and Warren Counties are not listed because no production was reported.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Ashe.—Ashe County ranked fourth in value of mineral production. Appalachian Sulphides, Inc., recovered copper, gold, and silver at the Ore Knob mine. Maymead Lime Co., Inc. (Longhope mine), mined paving sand. Joe L. Snyder mined a small quantity of sheet mica at the Knight mine. Ruth Stanley collected a small quantity of gem stones (malachite and smoky quartz).

Avery.—Cranberry Magnetite Corp. shipped a small quantity of magnetite from the Cranberry mine. Nineteen mica mines were active. The leading producers of sheet mica were Joe L. Snyder (Ground Hog, Charlie Ridge, and other mines), Avery & Buchanan (Meadow and Meadow No. 3 mines), and J. H. Young (Whistle Pig mine). Harris Clay Co. (Kaolin and Gushers Knob mines) was the leading producer of scrap mica. English Mica Co. and Harris Clay Co. ground mica for roofing, paint, rubber, wall paper, welding rods, well drilling, plastics, and miscellaneous uses. Harris Clay Co. mined kaolin at the Gushers Knob and Kaolin mines for whiteware, refractories, organic plastics, and other uses. The State highway commission mined 80,000 tons of paving gravel. Ruth Stanley collected a small quantity of gem stones (moonstone).

Beaufort.—J. D. McCotter, Inc. (Washington mine), and the State highway commission mined structural and paving sand.

Bertie.—The State highway commission mined 3,000 tons of paving sand.

Bladen.—The State highway commission mined 128,000 tons of paving and fill sand.

Brunswick.—The State highway commission mined 21,000 tons of paving sand.

Buncombe.—Seven operators mined structural and paving sand and gravel. The leading producers were Grove Stone & Sand Branch (Grove mine) and McCrary Construction Service (Barnardsville mine). The State highway commission crushed granite for concrete and roads at the Weaverville quarry. Asheville Mica Co. ground mica for paint, rubber, and joint cement uses.

Burke.—A. P. Causby Sand & Stone Co., McCrary Construction Service (Lake James mine), and the State highway commission mined sand and gravel for structural and paving uses. Ruth Stanley collected a small quantity of gem stones (rhodolite garnets and amethyst). Great Lakes Carbon Corp. manufactured carbon and graphite products at the plant.

Cabarrus.—F. T. Williams Co. and the State highway commission mined paving sand and gravel. Young Stone Co. crushed traprock for concrete and roads at the Gold Hill quarry. The State highway commission crushed granite for concrete and roads. Ruth Stanley and Lewis Blackwelders collected a small quantity of gem stones (gold ore and amethyst).

Caldwell.—Miller Brothers Co. and the State highway commission mined sand and gravel for structural and paving uses.

Camden.—The State highway commission mined 6,000 tons of paving sand.

Carteret.—The State highway commission mined 4,000 tons of paving sand.

Caswell.—W. E. Graham & Sons, a division of Vulcan Materials Co. (Shelton quarry), and the State highway commission (Ivy Bluff quarry) produced granite for riprap, concrete, roads, railroad ballast, and stone sand. The State highway commission mined 20,500 tons of paving sand. Ruth Stanley collected a small quantity of gem stones (amethyst).

Catawba.—Superior Stone Co. crushed granite for concrete and roads at the Hickory quarry. Statesville Brick Co. mined miscellaneous clay for heavy clay products. The State highway commission mined paving sand at the Catawba mine. Warren Stamey produced sheet mica at the Rhoney mine. Ruth Stanley collected a small quantity of gem stone (golden beryl, rhodolite garnets, and red spinel).

Chatham.—Boren Clay Products Co. (Gulf mine), Pomona Terra Cotta Co., Chatham Brick & Tile Co., Inc., and Cherokee Brick Co. of North Carolina (Brickhaven mine) mined miscellaneous clay for heavy clay products. The State highway commission crushed traprock for concrete and roads at the Goldston quarry.

Cherokee.—Max Zuckerman produced a small quantity of gold and silver. Columbia Marble Co. (Pleasant Valley quarry) quarried dimension marble; rough block, sawed and cut interior stones; cut, dressed monumental stone; and crushed marble for terrazzo and other uses. Hitchcock Corp. (Nancy Jordan mine) and Minerals & Metals Corp. (Mulberry Gap mine) mined talc for textiles, toilet preparations, and other uses. The State highway commission crushed granite for concrete and roads at the Dockery quarry.

Chowan.—The State highway commission mined 2,400 tons of paving sand.

Cleveland.—Cleveland County ranked third in value of mineral production. Superior Stone Co. crushed limestone at the Kings Mountain quarry and traprock at the Kings Mountain No. 2 quarry for concrete and roads. Shelby Sand & Stone, Inc. (First Broad River mine), and the State highway commission mined sand for structural, paving, fill, and other uses. Eight mica mines were active. Joe L. Snyder (Huskins and Mull mines) was the leading producer of sheet mica. Kings Mountain Mica Co., Inc. (Moss and Patterson mines), Western Mica of Carolina, Inc., and Foote Mineral Co. (Kings Mountain mine) produced scrap mica. Bennett Brick & Tile Co. mined miscellaneous clay for heavy clay products. Foote Mineral Co. mined and processed lithium minerals at Kings Mountain; it also produced a small quantity of byproduct feldspar for glass uses. Lithium Corporation of America processed lithium minerals at Bessemer City.

Columbus.—The State highway commission mined 107,000 tons of paving and fill sand.

Craven.—Superior Stone Co. crushed limestone for concrete and roads at the New Bern quarry. Southern Sand Co., Inc. (New Bern mine), and the State highway commission mined structural and paving sand.

Cumberland.—Becker County Sand & Gravel Co. (Fayetteville mine) and the State highway commission mined sand and gravel for structural, paving, fill, and railroad ballast uses. Ideal Brick Co. (Linden mine) mined miscellaneous clay for heavy clay products.

Currituck.—The State highway commission mined 58,300 tons of paving sand.

Dare.—The State highway commission mined 5,000 tons of paving sand.

Davidson.—Superior Stone Co. (Lexington quarry) crushed limestone for concrete and roads. Cunningham Brick Co. mined miscellaneous clay for heavy clay products at the Thomasville mine. Jacob's Creek Stone Co., Inc. (Flagstone quarry), quarried dimension slate for structural millstock and flagging. The State highway commission mined paving sand and gravel.

Davie.—The State highway commission mined 70,000 tons of paving sand.

Duplin.—James W. Kelly (Wallace mine) and the State highway commission mined structural, paving, and fill sand.

Durham.—Nello L. Teer Co. produced traprock for riprap, concrete, and roads. Borden Brick & Tile Co. and Tri-Angle Brick Co. mined miscellaneous clay for heavy clay products. Harley Hines collected a small quantity of gem stones (agate).

Edgecombe.—Nello L. Teer Co. (Rocky Mount quarry) crushed granite for concrete and roads. Tar River Sand & Gravel (Whitehurst mine) and the State highway commission mined structural and paving sand.

Forsyth.—W. E. Graham & Sons produced granite for riprap, concrete and roads, stone sand, and other uses at the North, No. 421, Piedmont, and South Fork quarries. The State highway commission mined 110,000 tons of paving sand. Ruth Stanley collected a small quantity of gem stones (almandite garnets).

Franklin.—The State highway commission mined 9,800 tons of paving sand.

Gaston.—Superior Stone Co. crushed granite, for concrete and roads, at the Gaston quarry. Kendrick Brick & Tile Co. mined miscellaneous clay for heavy clay products at the Mount Holley mine. The State highway commission mined paving sand.

Gates.—The State highway commission mined 12,500 tons of paving sand.

Granville.—The State highway commission mined 7,000 tons of paving sand. Ruth Stanley and Harley Hines collected a small quantity of gem stones (agate, jasper, hematite, and fluorescent calcite).

Greene.—The State highway commission mined 87,300 tons of paving sand.

Guilford.—Guilford County ranked fifth in value of mineral production. Superior Stone Co. (Pomona, Jamestown, Buchanan, and McLeansville quarries) and W. E. Graham & Sons (Stokesdale quarry) produced granite for riprap, concrete and roads, railroad ballast, and stone sand. Superior Stone Co. crushed traprock, for concrete and roads, at the Hicone quarry. Boren Clay Products Co. (Pleasant Garden mine) mined miscellaneous clay for heavy clay products. The State highway commission mined paving sand.

Halifax.—Nash Brick Co., Inc. (Ita mine), mined miscellaneous clay for heavy clay products. The State highway commission mined paving sand.

Harnett.—Becker County Sand & Gravel Co. (Senter mine), Nello L. Teer Co. (Erwin mine), and the State highway commission mined sand and gravel for structural, paving, fill, and other uses. Norwood Brick Co. mined miscellaneous clay for heavy clay products at the Lillington mine.

Haywood.—Sale & Alexander (Waynesville mine) and the State highway commission mined structural and paving sand and gravel.

Henderson.—Fletcher Limestone Co., Inc. (Fletcher quarry), and Cogdill Limestone Co. (Cogdill quarry) crushed limestone for concrete, roads, and other uses. Fletcher Brick Co., Inc. (Fletcher mine), mined miscellaneous clay for heavy clay products.

Hertford.—The State highway commission mined 75,000 tons of paving sand.

Hoke.—Pleasant Sand & Supply Co. (Ashley Heights mine) and the State highway commission mined structural and paving sand.

Hyde.—The State highway commission mined 1,800 tons of paving sand.

Iredell.—Superior Stone Co. crushed granite for concrete and roads at the Statesville quarry. Tarheel Construction Co. (Statesville mine) and the State highway commission mined paving sand.

Jackson.—Harbison-Walker Refractories Co. (Addie mine) and Balsam Gap Co. (Balsam Gap mine) mined olivine for refractories. Rock Products, Inc. (Dillsboro quarry), crushed granite for concrete and roads. Four mica mines were active. The leading producer of sheet mica was Clyde Frizzell (Wilson mine).

Johnston.—Nello L. Teer Co. (Princeton quarry) produced traprock for riprap, concrete, and roads. The State highway commission mined paving sand and gravel. Harley Hines collected a small quantity of gem stones (petrified wood).

Jones.—Simmons Marl & Lime Co. (Simmons mine) and the State highway commission mined sand and gravel for paving and fill uses.

Lee.—Sanford Brick & Tile Co., Inc., Borden Brick & Tile Co., Lee Brick & Tile Co., and Hanford Brick Co. mined miscellaneous clay for heavy clay products. The State highway commission mined paving sand.

Lenoir.—Barrus Construction Co. (Kinston mine) and the State highway commission mined sand and gravel for structural, paving, fill, and other uses.

Lincoln.—Duke Power Co. (Cowans Ford quarry) and Superior Stone Co. (Denver quarry) produced granite for riprap, concrete, roads, railroad ballast, and stone sand. The State highway commission mined paving sand. D.S. Buchanan mined a small quantity of sheet mica at the Mull mine. Ruth Stanley, Harley Hines, and Green's Mineral & Gift Shop collected a quantity of gem stones (amethyst).

Macon.—Fourteen mines produced mica. The leading producers of sheet mica were Roy H. Fouts (Allman Cove and Rock Cut mines), B-K Associates, Inc. (Bryson mine), and J. E. Wilson (Chalk Hill mine). The leading producer of scrap mica was A & C Mica Co. (Sheppard Knob mine). Franklin Mineral Products Co. ground mica for paint, rubber, wall paper, plastic, and other uses. P. W. Halston, Richard Matyoh, Ruth Stanley, and Albert Topper collected gem stones (kyanite, ruby, and mica).

Madison.—Bar-Tex., Inc., mined barite at the Stackhouse mine. The State highway commission mined paving sand.

Martin.—The State highway commission mined 1,800 tons of paving sand.

McDowell.—Becker County Sand & Gravel Co. (Marion mine) and the State highway commission mined structural, paving, and railroad ballast sand and gravel. The State highway commission crushed limestone for concrete and roads at the Woodlawn quarry.

Mecklenburg.—Superior Stone Co. crushed granite at the Charlotte and Pineville quarries for concrete and roads. Charlotte Sand Co. and H. D. Bartlett Sand Co. mined sand for structural and paving uses.

Mitchell.—Mitchell County ranked first in value of mineral production. Fifty-four mines produced mica of which 46 produced sheet mica only (punch, full-trimmed and/or hand-cobbed), 6 produced scrap mica only, and 2 produced both sheet and scrap mica. The leading producers of sheet mica were McBee Mining Co. (McBee and Johnson mines), P & H Mining Co. (Gudger mine), Mountain Mining Co. (Jimmy Cut mine), and Sink Hole Miners (Sink Hole mine). The leading producers of scrap mica, International Minerals & Chemical Corp. and The Feldspar Corp., both recovered byproduct mica at their feldspar flotation plants. Five companies ground mica for roofing, paint, rubber, wallpaper, well drilling, plastics, and other uses. The leading producer was Carolina-Southern Mining Co., Inc. International Minerals & Chemical Corp. (Hawkins and Kona mines), The Feldspar Corp. (Poteat, Wiseman, and Sullins mines), and Lawson-United Feldspar & Minerals Co. (Minpro mine) mined crude feldspar rock to produce both flotation grade and ground feldspar for glass, pottery, and enamel uses; they also recovered crushed sandstone (quartz) from feldspar milling. Green's Mineral & Gift Shop, Gene Curtis, Richard Matych, Ruth Stanley, and Albert Topper collected small quantities of gem stones (hyalite opal, golden beryl, emerald, garnet, and actinolite).

Montgomery.—Union Refining & Mining Co. recovered gold and silver at the Star mine. Mt. Gilead Brick Co. mined miscellaneous clay for heavy clay products. Jacob's Creek Stone Co., Inc. (Edenboro quarry), quarried dimension slate for structural millstock and flagging. McCrary Associates and the State highway commission (Farrington and Candor mines) mined paving sand.

Moore.—Standard Mineral Co., Inc. (Underground mine), and General Minerals Co. (Glendon mine) mined pyrophyllite for ceramics, insecticides, paint, rubber, refractory, and plastics uses. Five operators mined sand and gravel for structural, paving, and fill uses; the leading producers were Pleasants Sand & Supply Co. (Pleasants mine) and the State highway commission. Ceramic Minerals, Inc. (Robbins mine), and T & H Clay Co., Inc. (Hancock mine), mined miscellaneous clay for heavy clay products. Ruth Stanley collected a small quantity of gem stones (radiating talc).

New Hanover.—Robbins Sand Pit and the State highway commission mined paving and fertilizer filler sand.

Northampton.—Superior Stone Co. (Garysburg mine) and the State highway commission mined structural and paving sand and gravel.

Onslow.—Superior Stone Co. crushed limestone for concrete and roads at the Belgrade quarry. The State highway commission mined paving sand.

Orange.—Superior Stone Co. crushed traprock at the Eno quarry for concrete and roads. Piedmont Minerals Co., Inc. (Hillsboro mine), mined pyrophyllite for ceramics and refractory purposes. Duke University quarried dimension granite at the Hillsboro quarry for rough construction use. The State highway commission crushed granite for concrete and roads at the Bacon quarry.

Pamlico.—The State highway commission mined 3,000 tons of paving sand.

Pasquotank.—The State highway commission mined 15,000 tons of paving sand.

Pender.—The State highway commission mined 9,000 tons of paving sand.

Perquimans.—The State highway commission mined 4,000 tons of paving sand.

Person.—The State highway commission mined 5,800 tons of paving sand. Ruth Stanley collected a small quantity of gem stones (malachite).

Pitt.—Superior Stone Co. crushed granite, for concrete and roads, at the Fountain quarry. Concrete Products Co. (Greenville mine), White Concrete Co., Inc. (Munford mine), and the State highway commission mined structural and paving sand.

Polk.—The State highway commission mined 76,000 tons of paving sand and gravel.

Randolph.—The State highway commission crushed granite for concrete and roads at the Parks Cross Road and Glenola quarries.

Richmond.—The State highway commission mined paving sand and gravel at the McLeod mine.

Robeson.—The State highway commission mined 169,000 tons of paving sand.

Rockingham.—Superior Stone Co. (Reidsville quarry) and the State highway commission (Newman quarry) crushed granite for concrete and roads. M. Lester Hall crushed traprock for concrete and roads at King's quarry. Solite Corp. (Leakesville mine) and Webster Brick Co., Inc. (Draper mine), mined miscellaneous clay for lightweight aggregates and heavy clay products. The State highway commission mined paving sand.

Rowan.—Seven quarries produced dimension granite for use as rubble, dressed architectural stone, rough and dressed monumental stone, and curbing and flagging. The leading producer was Harris Granite Quarries Co. (Collins, Balfour, and Shuping quarries). Superior Stone Co. (Woodleaf quarry) crushed granite for concrete and roads. Gardner Granite Works produced millstones. Carolina Tuff-Lite Corp. and Isenhour Brick & Tile Co. (East Spencer mine) mined miscellaneous clay for lightweight aggregate and heavy clay products. The State highway commission mined paving sand. Carolina Perlite Co., Inc., expanded perlite at the Gold Hill plant.

Rutherford.—A. R. Thompson, contractor, and the State highway commission mined paving sand and gravel. Grady Campbell (Bridges and McFarland mines) mined a small quantity of sheet mica.

Sampson.—Crumpler Brick & Tile Co., Inc., Patterson Brick Co., and Sampson Brick Co., Inc., mined miscellaneous clay for heavy clay products. The State highway commission mined 15,000 tons of paving sand.

Scotland.—The State highway commission mined 13,000 tons of paving sand.

Stanly.—Southern Lightweight Aggregate Corp. (Aquadale mine), Stanley Shale Products, Inc. (Norwood mine), and Yadkin Brick Yards, Inc. (Yadkin mine), mined miscellaneous clay for lightweight aggregate and heavy clay products. The State highway commission (McManus quarry) crushed traprock for concrete and roads and mined paving sand and gravel. Aluminum Co. of America produced primary aluminum at its smelter at Badin.

Stokes.—Pine Hall Brick & Pipe Co. (No. 1 mine) mined miscellaneous clay for heavy clay products. M & L Mining Co. (Mabe mine), Julius Henline (Spencer mine), and Joe L. Snyder (Steel mine) produced sheet mica. The State highway commission mined 106,000 tons of paving sand. Harley Hines collected a small quantity of gem stones (flexible sandstone).

Surry.—North Carolina Granite Corp. (Mount Airy quarry) quarried dimension granite for rubble, rough and dressed construction stone, rough and dressed architectural stone, rough and dressed monumental stone, curbing, flagging, and paving blocks. North Carolina Granite Corp. (Mount Airy quarry) and W. E. Graham & Sons (Elkins, Mount Airy, and Pilot Mountain quarries) produced granite for riprap, stone sand, poultry grit, concrete, and roadstone. The State highway commission mined paving sand. Ruth Stanley collected a small quantity of gem stones (blue corundum, quartz crystals, blue massive sapphire, unakite, and carnelian).

Swain.—Nantahala Talc & Limestone Co. (Hewitt quarry) crushed limestone for concrete, roads, railroad ballast, and agstone. J.L. Colville Construction Co. (Colville quarry) crushed granite for concrete and roads. The Feldspar Corp. (Alexander, McCracken, and Rigeler mines) mined crude feldspar.

Transylvania.—Macon Construction Co. quarried dimension granite for rubble and crushed granite at the Penrose quarry for concrete and roads. James E. Moore (Fred Hall mine) mined a small quantity of sheet mica. Siniard Brothers mined a small quantity of structural sand.

Tyrrell.—The State highway commission mined 1,800 tons of paving sand.

Union.—Superior Stone Co. (Bakers quarry) and the State highway commission (Monroe quarry) crushed traprock for concrete and roads. Kendrick Brick & Tile Co. (Monroe mine) mined miscellaneous clay for heavy clay products. The State highway commission mined 8,000 tons of paving sand.

Vance.—Vance County ranked second in value of mineral production. Tungsten Mining Corp. mined tungsten ore at the Hamme mine and also recovered silver, lead, copper, and gold from tungsten mill tailings. W. E. Graham & Sons (Greystone quarry) produced granite for riprap, concrete, roads, railroad ballast, and stone sand.

Wake.—Superior Stone Co. (Crabtree, Rolesville, and Garner quarries) and Nello L. Teer Co. (Raleigh quarry) produced granite for riprap, concrete, roads, and railroad ballast. The State highway commission mined 3,500 tons of paving sand. Harley Hines collected a small quantity of gem stones (sardonyx and smoky quartz).

Washington.—The State highway commission mined 3,400 tons of paving sand.

Watauga.—Maymead Lime Co., Inc. (Maymead mine), and the State highway commission mined paving gravel. Ruth Stanley collected a small quantity of gem stones (honey onyx).

Wayne.—Nello L. Teer Co., Superior Stone Co., and the State highway commission mined structural and paving sand. Harley Hines collected a small quantity of gem stones (petrified wood).

Wilkes.—Rock Products, Inc., and the State highway commission mined paving sand. Ruth Stanley collected a small quantity of gem stones (agate).

Wilson.—Superior Stone Co. (Neverson and Elm City quarries) crushed granite for concrete and roads. Baltzegar Pits (Wilson mine), Deans Sand Co., Grey Concrete Pipe Co., Inc. (Stantonsburg mine), and the State highway commission mined sand and gravel for structural, paving, fill, and other uses.

Yadkin.—W. E. Graham & Sons (Cycle quarry) produced granite for riprap, concrete, roads, and stone sand. E. R. Short & Sons (Dooley quary) crushed limestone for concrete and roads. The State highway commission mined paving sand.

Yancey.—Twenty-two mines produced sheet mica only (punch, full-trimmed and/or hand-cobbed), and 2 scrap mica only. The leading producers of sheet mica were Gouge & Allen (Barger mine) and Ted Ledford (Ayles Creek mine). The two producers of scrap mica were Deneen Mica Co. (Young mine) and Hassett Mining Co. (Simpson mine). McCrary Associates (Pensacola mine) and Yancey Sand & Gravel Co., Inc. (Fox mine), mined paving sand and gravel. Wiseman Mining Co., Inc. (Wray mine), and Georgia Talc Co. (Spruce Pine mine) mined olivine. Powhatan Mining Co. mined asbestos at the Burnsville mine. Hassett Mining Co. and Deneen Mica Co. ground mica for roofing, well drilling, and other uses. The Feldspar Corp. ground feldspar for glass, pottery, enamel, and other uses at the Burnsville plant.

The Mineral Industry of North Dakota

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of North Dakota.

By D. H. Mullen[1]

◆

MINERAL production in North Dakota in 1961 was valued at $85 million, a gain of $6 million or 8 percent over that of 1960. Mineral fuels—coal (lignite), natural gas, natural gas liquids, and crude petroleum—represented 90 percent of the total value of all minerals produced in the State, 7 percent more than in 1960. Gains were recorded in the production of each of these mineral fuels except natural gasoline, which declined by less than 1 percent. The output of lignite rose for the third consecutive year.

Exploratory and development drilling for oil and gas again declined; however, three new fields were discovered and new producing horizons were found in three other fields. North Dakota was 11th in rank in the Nation in primary oil reserves with 414 million barrels.

TABLE 1.—Mineral production in North Dakota[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	[2] 102	[2] $129	(3)	(3)
Coal (lignite) do	2,525	5,790	2,726	$6,141
Gem stones	(4)	1	(4)	1
Natural gas million cubic feet	19,483	2,221	20,100	2,583
Petroleum (crude) thousand 42-gallon barrels	21,992	59,598	[5] 23,568	[5] 64,105
Sand and gravel thousand short tons	8,648	6,904	9,395	7,507
Stone do	28	44	40	40
Value of items that cannot be disclosed: Clays (bentonite, fire clay 1960), natural gas liquids, salt, and values indicated by footnote 3		3,691		4,370
Total North Dakota		[6] 78,378		84,697

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes bentonite and fire clay; included with "Value of items that cannot be disclosed."
[3] Figure withheld to avoid disclosing individual company confidential data.
[4] Weight not recorded.
[5] Preliminary figure.
[6] Revised figure.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

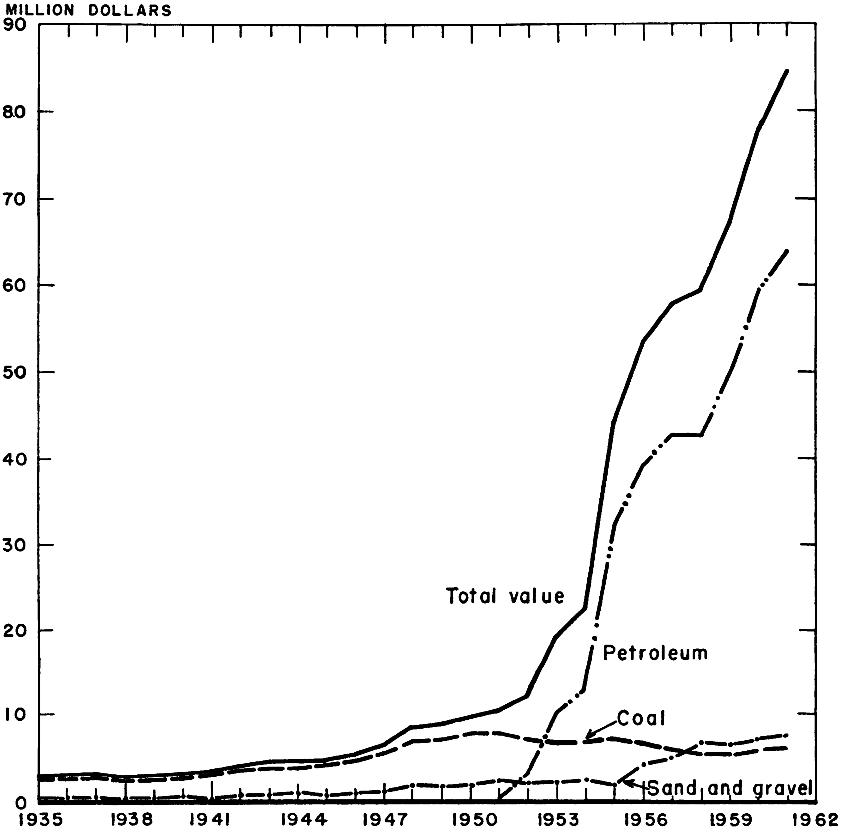

FIGURE 1.—Value of sand and gravel, petroleum, and coal, and total value of mineral production in North Dakota, 1935–61.

Gains were recorded in the production and value of all nonmetals except clays. Of particular significance was the more than sixfold increase in salt production, all of which came from wells in Williams County. The recovery of the salt by solution mining, which began in June 1960, had created storage capacity for 180,000 barrels of liquid petroleum gases.

Employment and Injuries.—Final employment and injury data for 1960 and preliminary data for 1961 in the mineral industry, excluding petroleum, collected by the Bureau of Mines are shown in table 2.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Lignite).—Coal production from 1 underground and 31 strip mines in 15 counties increased 8 percent in quantity and 6 percent in value over that of 1960. Gains were recorded in nine counties and declines in six. The gains ranged from 1 to 51 percent, whereas the

TABLE 2.—Employment and injuries in the mineral industries in North Dakota [1]

Industry	Number of operations [2]	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Nonfatal	
1960:						35.1
Coal mines	41	344	541,394	1	18	29.5
Nonmetal mines and mills	9	76	101,776		3	
Stone quarries and plants	6	5	7,888			
Sand and gravel plants	147	805	933,033	2	22	25.7
Total	203	1,230	1,584,091	3	43	29.0
1961: [3]						
Coal mines	40	317	530,531		12	22.6
Nonmetal mines and mills	11	109	182,357		1	5.5
Stone quarries and plants	6	18	8,560			
Sand and gravel plants	212	884	1,201,354		1	0.8
Total	269	1,328	1,922,802		14	7.3

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Preliminary figures.

declines varied from less than 1 percent to 38 percent. Considerable attention was given to proposals by the Lignite Electric Power Cooperative and the Basin Electric Power Cooperative for the construction of thermal electric powerplants in central North Dakota. Both plants would have an initial capacity of 200 megawatts and would use lignite for fuel. Lignite Electric Power Cooperative, composed of Minnekota Power, Central Power Electric, and Dakota Electric Cooperatives, would sell power to members and nonmembers. Basin Electric Power Cooperative would provide service only to public power organizations. Both groups applied for substantial loans from the Rural Electrification Administration (REA) to construct the pro-

TABLE 3.—Coal (lignite) production by counties

(Excludes mines producing less than 1,000 short tons)

County	1960		1961	
	Short tons	Average value per ton [1]	Short tons	Average value per ton [1]
Adams	11,787	$3.80	17,849	$3.66
Bowman	147,279	1.74	172,058	1.89
Burke	406,600	2.27	410,858	2.33
Burleigh	14,132	3.33	13,084	3.33
Divide	227,720	2.57	214,659	2.45
Dunn	5,793	3.00	6,148	2.92
Grant	21,181	3.03	21,964	2.87
Hettinger	5,000	3.30	3,100	3.70
McLean	76,099	3.33	82,597	3.18
Mercer	1,019,039	2.18	1,053,013	2.16
Morton	21,844	2.59	18,888	2.51
Oliver	8,748	2.25	8,728	2.41
Stark	75,224	1.95	102,278	1.88
Ward	482,106	2.33	599,065	2.22
Williams	2,403	4.71	1,981	4.78
Total	2,524,955	2.29	2,726,270	2.25

[1] Value received or charged f.o.b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

posed generating plants. At yearend neither application had been granted.

A $10.5 million project by Montana-Dakota Utilities Co. at the R. M. Heskett plant at Mandan began in March. The project included a new boiler, a 66-megawatt generator, and auxiliary facilities that would increase capacity of the plant to 91 megawatts. Completion was expected late in 1963.

The Federal Bureau of Mines continued its research at the Charles R. Robertson Lignite Research Laboratory at Grand Forks. Major activities were focused on the technology of lignite coals, and included studies of storage, freezeproofing, drying, size reduction and pulverization, carbonization, gasification, tar assay and characterization, and the chemical and physical properties of lignite and its products. Reports [2] describing some of the results of the research were published.

Natural Gas.—The quantity of dry natural gas from two fields in Bowman County and residual gas from oil-well gas processed at natural gas plants, both marketed through pipelines to consumers, was 3 percent greater than that of 1960. Signal Oil and Gas Co. operated its gas processing plant at Tioga, and two new plants were nearing completion. Hunt Oil Co. was completing a plant in the McGregor area in northeastern Williams County, and Oil-Chem Corp. and TXL Oil Corp. had completed a plant at Lignite in northern Burke County and was preparing for initial operations at yearend. Residual gas from these plants was to be marketed through pipelines of Montana-Dakota Utilities Co. According to reports,[3] total production of dry natural gas was 423 million cubic feet and 16.5 billion cubic feet of oil-well gas was treated at processing plants; of the latter, 5.2 billion cubic feet was marketed.

Natural Gas Liquids.—Natural gasoline, butane, and propane recovered by Signal Oil and Gas Co. at its processing plant at Tioga was 2 percent above that of 1960. However, because of a lower unit price, the total value declined by 6 percent. The natural gasoline recovered was used at oil refineries for blending stock. Butane and propane were stored in underground caverns created by solution mining of salt, and the excess was transported to oil refineries. Data compiled by the State Geological Survey [4] showed that 11.9 million gallons of natural gasoline, 20.8 million gallons of butane, 36.4 million gallons of propane, and 19,351 long tons of sulfur were recovered.

Petroleum.—The year 1961 marked the 10th anniversary of the discovery of oil in North Dakota at the Clarence Iverson No. 1 well in the Beaver Lodge field, Williams County, on April 4, 1951. Initial production was from a Silurian formation, and on July 19, 1951, production was obtained from a Devonian formation which was still producing in 1961. Total crude oil production in the State through 1961 was nearly 128 million barrels. Production in 1961 was 23.6 million barrels, a 7-percent increase over that of 1960.

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[2] Beckering, W., and W. W. Fowkes. Infrared Spectra of Hydroxy-Aromatic Organic Compounds (Supplement to R.I. 5505). BuMines Rept. of Inv. 5806, 1961, 34 pp.

Ellman, R. C., and J. W. Belter. Pulverizing Lignite in a North Dakota Powerplant. BuMines Inf. Circ. 8032, 1961, 31 pp.

Fowkes, W. W., C. M. Frost, J. J. Hoeppner, W. Beckering, P. G. Freeman, and R. W. Youngs. An Examination of a Low-Temperature Tar From a North Dakota Lignite. BuMines Rept. of Inv. 5813, 1961, 27 pp.

Porter, R. B., W. H. Oppelt, and W. R. Kube. Low-Temperature Carbonization of Lignite and Subbituminous Coal: Effect of Hydrogen Atmosphere to 1,000 Pounds Pressure. BuMines Rept. of Inv. 5804, 1961, 25 pp.

[3] Laird, Wilson M. Oil in North Dakota, First Half 1961. North Dakota Geol. Survey Bull., October 1961, 114 pp.

Laird, Wilson M. Oil in North Dakota, Second Half 1961. North Dakota Geol. Survey Bull., April 1962, 120 pp.

[4] Work cited in footnote 3.

TABLE 4.—Crude petroleum production, by counties [1]

(Thousand barrels)

County	1960	1961 [2]	Principal fields [3] in 1961 in order of output
Billings	477	607	Rocky Ridge, Fryburg.
Bottineau	2,188	3,120	Newburg, South Westhope, Wiley, Haas, North Westhope.
Bowman	53	384	Cedar Creek.
Burke	3,989	3,945	Rival, North Tioga, Lignite, Flaxton, Portal, Black Slough, Rennie Lake.
Divide	469	443	North Tioga.
Dunn	40	66	
McHenry	8	10	
McKenzie	6,108	6,003	Blue Buttes, Antelope, Charlson, Clear Creek, Dimmick Lake, Rough Rider.
Mountrail	1,560	1,455	Tioga, White Earth.
Renville	902	1,378	Glenburn, Sherwood.
Stark	8	30	
Williams	6,190	6,127	Beaver Lodge, Tioga, Capa, McGregor, Hofflund.
Total	21,992	23,568	

[1] Based on North Dakota Geological Survey county data adjusted to Bureau of Mines total.
[2] Preliminary figures.
[3] Fields producing more than 100,000 barrels.

TABLE 5.—Wildcat- and development-well completions in 1961, by counties [1]

County	Crude	Dry	Total	Footage
Wildcat:				
Billings	1	2	3	33,300
Bottineau		22	22	86,600
Burke	1	5	6	42,000
Divide		3	3	22,700
Dunn		1	1	9,700
Golden Valley		1	1	9,800
McHenry		2	2	8,500
McKenzie	2	4	6	66,900
Mercer		1	1	8,500
Mountrail		2	2	16,500
Renville		10	10	45,000
Rolette		1	1	2,700
Slope		1	1	8,800
Walsh		1	1	1,800
Ward		6	6	35,800
Williams	2	6	8	73,300
Total	6	68	74	471,900
Development:				
Billings	4	4	8	109.500
Bottineau	47	14	61	231,500
Bowman	8		8	67,300
Burke	27	19	46	288,200
Divide	1		1	7,800
McHenry		2	2	8,600
McKenzie	17	6	23	227,900
Renville	12	9	21	93,100
Williams	9	5	14	90,300
Total	125	59	184	1,124,200
Total all drilling	131	127	258	1,596,100

[1] No condensate wells.

Source: Oil and Gas Journal.

Drilling declined from 82 exploratory wells and 201 development wells in 1960 to 74 and 184, respectively. Exploratory drilling in 1961 resulted in three new fields and three new producing horizons in existing fields.

The State geologist reported[5] that 63 exploratory wells were completed, of which 6 were successful; 14 output wells completed, 5 successful; 65 extension wells, 40 successful; and 115 development wells, 81 successful. Total footage drilled was 1.5 million feet compared with 1.7 million feet in 1960.

The success ratio for exploratory drilling was 9.5 percent, and the overall success ratio was 51.4 percent. Of the new field discoveries, one was east of the Nesson anticline and two were far removed from previous production. Probably the most significant discovery was the Grenora field in Williams County near the Montana State line. The Elkhorn Ranch field in Billings County was the farthest removed from previous production, being 9 miles south of the Rough Rider field. The third discovery, Dimond, was 6 miles southeast of the Foothills field in Burke County.

Development drilling was largely in fields east of the Nesson anticline. The greatest activity was in the Haas field in Bottineau County and the Black Slough field in Burke County. Field limits were extended as much as 3 miles. Other successful development drilling was done at the Sherwood field in Renville County and at the South Westhope field in Bottineau County.

Refineries at Mandan and Williston were operated throughout the year, and substantial additions to these facilities were completed. Throughput was 15.6 million barrels of crude oil, an increase of 4 percent compared with that of 1960. The Queen City refinery at Dickinson was enlarged and improved and had the only asphalt producing facility in the State.

NONMETALS

Clays.—Clays for the manufacture of building brick, draintile, other heavy clay products, and lightweight aggregate were produced in Adams, Divide, and Morton Counties. Total output of clays declined 23 percent in quantity and 19 percent in value. Clay produced in Stark County, classified as fire clay, was used in the manufacture of heavy clay products. A small quantity of bentonite produced in Morton County was used in the manufacture of prepared mortars.

Gem Stones.—Gem material (agate, agatized wood, chalcedony, jasper, and quartzite) was collected by individuals and gem societies largely in Billings, Morton, and Stark Counties.

Salt.—Salt production, by solution mining through two wells drilled into the Charles formation at depths of approximately 8,500 feet, was more than six times that of 1960. Drilling of a third well was started in February. The caverns created through mining of the salt were used to store liquid petroleum gases.

Sand and Gravel.—Sand and gravel production from deposits in 49 of the State's 53 counties was 9 percent greater in quantity and value than that of 1960. The major portion of the production (82 percent) was by Government agencies and contractors for use in road construction and repair. Production by 41 commercial operators in 25 counties and representing 18 percent of the total was used for building (36 percent), paving (43 percent), railroad ballast (9 percent), and fill and miscellaneous uses (12 percent). The average value of sand and gravel from Government-and-contractor operations was $0.76 per ton and ranged from $0.50 for building sand to $0.76 for washed and sized material used in highway construction, which was the principal use. Commercial production averaged $0.96 per ton and ranged from $1.99 for prepared gravel for building to $0.38 for material used for fill and other purposes. Fifty percent of the commercial production and 55 percent of the Government-and-contractor production was washed, sized, or otherwise prepared. Major production was from Cass (1,019,100 tons), Ward (853,100 tons), Barnes (651,700 tons), Williams (493,400 tons), Stutsman (468,200 tons), and Pembina (462,500 tons) Counties.

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[5] Work cited in footnote 3.

TABLE 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Construction sand:				
Building	341	$395	297	$348
Paving	34	48	61	59
Railroad ballast	------	------	(1)	(1)
Fill	9	8	26	17
Other	1	(2)	2	2
Total sand	385	451	386	426
Construction gravel:				
Building	390	706	322	640
Paving	2,171	1,224	671	450
Railroad ballast	180	58	154	70
Fill	106	42	163	61
Other	28	13	23	7
Miscellaneous gravel	31	24	(1)	(1)
Total gravel	2,906	2,067	1,333	1,228
Total sand and gravel	3,291	2,518	1,719	1,654
Government-and-contractor operations:				
Sand:				
Building	7	9	18	9
Paving	420	243	391	299
Total sand	427	252	409	308
Gravel:				
Building	47	64	111	73
Paving	4,883	4,070	7,145	5,464
Fill	------	------	9	7
Other	------	------	2	1
Total gravel	4,930	4,134	7,267	5,545
Total sand and gravel	5,357	4,386	7,676	5,853
All operations:				
Sand	812	703	795	734
Gravel	7,836	6,201	8,600	6,773
Grand total	8,648	6,904	9,395	7,507

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Less than $500.

Construction of the National System of Interstate and Defense Highways accounted for the high rate of production. A report[6] by the U.S. Bureau of Public Roads showed that 26 miles of highway was improved to full standards during the year. At the end of the year 203.1 miles of the system was open to traffic, of which 163.7 miles was full standard and 39.4 miles was adequate for present traffic. At yearend 43.1 miles of the system was under construction, and engineering and right-of-way acquisition had started on 91.7 miles. Of the 567.9 miles of the system designated to the State, 230 miles remained to be planned and built. Sections of two highways of the Interstate System traverse the State: Interstate 29 north and south from Canada through Grand Forks and Fargo and Interstate 94 east and west from Fargo through Bismarck and into Montana.

Stone.—Crushed stone, used for highway construction, was produced in 17 counties by contractors for the State highway department. The quantity produced was 43 percent above that of 1960.

Sulfur.—Shipments of elemental sulfur recovered at the natural gas processing plant at Tioga totaled 29,186 long tons, a 14-percent increase over 1960.

Vermiculite.—Crude vermiculite from deposits in Montana was exfoliated at a plant in Ward County and used for insulation, in lightweight aggregate, and as a soil conditioner. The quantity shipped was 3 percent above that of 1960.

METALS

Uranium.—The conditions necessary for the final execution of a contract to purchase 3.75 million pounds of uranium oxide to be recovered from uraniferous lignites in North Dakota, South Dakota, and Montana had not been met at the end of the year. Negotiations between the U.S. Atomic Energy Commission (AEC) and International Resources Corp. had been in progress for more than 2 years. AEC established January 2, 1962, as the final date on which International Resources Corp. must present assurances establishing adequate financial arrangements for construction of the proposed mill and operation of the mill by Susquehanna-Western, Inc., or the purchase contract that had been approved for execution would be canceled. During the year, leaseholders in the lignite area began negotiations with Gunnison Mining Co., a subsidiary of Kerr-McGee Oil Industries, Inc., to construct a mill if the contract between AEC and International Resources Corp. was not consummated.

REVIEW BY COUNTIES

Only those counties with significant production are discussed below. See table 7 for additional details.

Barnes.—The county ranked third in production of sand and gravel, most of which was used in the construction of Interstate Highway 94.

Billings.—Petroleum production from 32 wells in 6 fields was 27 percent above that of 1960. Major production was from the Fryburg field from the Heath and Madison formation and the Rocky Ridge

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[6] Bureau of Public Roads, Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1961, Press Release BPR 62–4, Feb. 7, 1962.

TABLE 7.—Value of mineral production in North Dakota, by counties

County	1960	1961 [1]	Minerals produced in 1961 in order of value
Adams	$148,791	$65,502	Coal, clays.
Barnes	315,600	447,200	Sand and gravel.
Benson	92,400	102,400	Do.
Billings	[2] 1,293,900	1,706,336	Petroleum, sand and gravel, stone, gem stones.
Bottineau	[2] 5,930,500	8,509,100	Petroleum, sand and gravel.
Bowman [3]	401,945	1,388,333	Petroleum, coal, sand and gravel, stone.
Burke [4]	[2] 11,808,220	11,748,532	Petroleum, coal, sand and gravel.
Burleigh	379,046	479,570	Sand and gravel, coal.
Cass	180,800	911,588	Sand and gravel, stone.
Cavalier	254,881	58,437	Do.
Dickey	30,800	95,031	Do.
Divide	2,003,710	2,027,058	Petroleum, coal, sand and gravel, clays, stone
Dunn	174,779	267,310	Petroleum, sand and gravel, coal, stone.
Eddy	(5)	194,300	Sand and gravel.
Emmons	18,700	95,100	Do.
Foster	7,200	8,912	Sand and gravel, stone.
Golden Valley	800	------------	
Grand Forks	194,155	166,900	Sand and gravel.
Grant	68,141	62,993	Coal.
Griggs	5,400	7,300	Sand and gravel.
Hettinger	119,000	217,256	Sand and gravel, coal, stone.
Kidder	15,400	3,400	Sand and gravel.
LaMoure	23,800	19,800	Do.
Logan	17,500	56,600	Do.
McHenry	(5)	149,900	Sand and gravel, petroleum.
McIntosh	2,000	67,900	Sand and gravel.
McKenzie [4]	[2] 16,781,200	16,614,347	Petroleum, sand and gravel, stone.
McLean	262,277	548,106	Sand and gravel, coal.
Mercer	(5)	(5)	Coal, sand and gravel.
Morton	196,988	258,723	Sand and gravel, clays, coal, gem stones.
Mountrail [4]	[2] 4,229,100	4,082,700	Petroleum, sand and gravel.
Nelson	20,500	103,513	Sand and gravel, stone.
Oliver	19,682	38,413	Coal, sand and gravel.
Pembina	245,320	313,600	Sand and gravel.
Pierce	37,200	28,900	Do.
Ramsey	4,500	5,212	Sand and gravel, stone.
Ransom	61,900	40,800	Sand and gravel.
Renville	[2] 2,444,000	3,801,500	Petroleum, sand and gravel.
Richland	43,673	37,100	Sand and gravel.
Rolette	39,800	65,600	Do.
Sargent	68,100	134,832	Sand and gravel, stone.
Sheridan	53,100	32,500	Sand and gravel.
Sioux	101,400	------------	
Slope	------------	18,878	Sand and gravel, stone.
Stark	259,298	408,422	Coal, sand and gravel, petroleum, clays, stone, gem stones.
Steele	98,400	39,200	Sand and gravel.
Stutsman	380,500	397,600	Do.
Towner	900	300	Do.
Traill	95,700	261,199	Sand and gravel, stone.
Walsh	227,700	204,200	Sand and gravel.
Ward	1,644,081	2,153,288	Coal, sand and gravel.
Wells	64,700	8,613	Sand and gravel, stone.
Williams [4]	[2] 17,103,662	17,986,240	Petroleum, salt, sand and gravel, coal, stone.
Undistributed [6]	10,406,930	8,256,487	
Total	[2] 78,378,000	84,697,000	

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[1] Petroleum value is preliminary.
[2] Revised figure.
[3] Excludes natural gas.
[4] Excludes natural gas and natural gas liquids.
[5] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[6] Includes natural gas liquids, natural gas, and some sand and gravel, stone (1960), and gem stones that cannot be assigned to specific counties, and values indicated by footnote 5.

field from the Heath. Shell Oil Co. and Great Northern Pacific Railway Co. completed an exploratory well at the Elk Horn Ranch field in sec. 5, T. 143 N., R. 101 W., which was 9 miles south of the Rough Rider field. Initial production was 136 barrels of oil a day, and total production for the year was 16,745 barrels from the Bakken member at 10,682 to 10,692 feet and the Three Forks member at 10,705 to 10,715 feet of the Devonian. Total depth of the well was

13,018 feet. One failure, previously drilled, was located between the Elk Horn Ranch and Rough Rider fields. No other drilling was done during the year. The Federal Bureau of Public Roads contracted for the production of paving gravel and crushed stone for road construction.

Bottineau.—Petroleum production from 265 wells in 16 fields increased 43 percent over that of 1960. Major production was from the Newburg, South Westhope, Wiley, and Haas fields. Development drilling at the Haas field increased the number of producing wells from 5 to 22. Field limits were extended nearly 3 miles to the northwest along a trend more than 1 mile wide. Successful development drilling was done at the South Westhope and Wiley fields with 16 and 4 new producers, respectively. Production was from the Spearfish (Triassic) and Charles (Mississippian) formations at the Newburg, South Westhope, and Starbuck fields and from the Madison (Mississippian) formation at the remainder. Contractors produced sand and gravel for the State highway department for road construction.

Bowman.—Petroleum production increased more than sevenfold from eight wells in two fields. The major increase was from the Cedar Creek field where two new producers were completed to the Red River (Ordovician) formation. Dry natural gas production from 28 wells in 2 fields, both producing from the Eagle sandstone, was 3 percent below that of 1960. The output was marketed through pipelines of Montana-Dakota Utilities Co. Knife River Coal Mining Co. operated its Peerless strip mine and increased coal output 17 percent. Sand and gravel and crushed stone were produced by contractors for the State highway department for road construction.

Burke.—The county ranked third in the production of coal (lignite) and petroleum. Petroleum production was from 266 wells in 19 fields; all output was from the Madison (Mississippian) limestone. One new field, Dimond, was discovered by Monsanto Chemical Co. at its No. 1 Swenson well in sec. 10, T. 160 N., R. 91 W., 6 miles southeast of the Foothills field. Initial production was 90 barrels of oil a day plus 43 percent water, on pump, from the Mission Canyon (Mississippian) formation at a depth of 7,114 to 7,121 feet. At the Black Slough field, discovered in 1959, development drilling was done on the eastern and western edges of the field, and production was extended 2 miles to the north. Four successful wells were completed north of an extension well drilled 1 mile north of the field in 1960. TXL Oil Co. was completing the construction of a natural gas plant at Lignite. The plant was designed to process 20 million cubic feet of oil-well gas a day, with the recovery of 25,000 gallons of natural gasoline, butane, and propane. About 15 tons of sulfur also would be recovered. The natural gas liquids would be sold through a marketing subsidiary of American Oil Co. Gas for the plant would come from the Portal, Rival, Black Slough, Foothills, Flaxton, and Woburn fields. Operation of the plant was expected to begin early in 1962. Truax-Traer Coal Co. operated its Kincaid strip mine, and LeRoy Bonsness operated the Bonsness strip mine. The total output of coal in the county was 1 percent above that of 1960. Sand and gravel was produced by contractors for the State and county highway departments for road construction. Sandberg Sand & Gravel produced building sand and gravel.

Cass.—The county ranked first in the production of sand and gravel; output was in excess of 1 million tons. The bulk of the production was by contractors for the State highway department and was used in the construction of Interstate Highway 94, the most northern of the east-west routes, and the intersection with Interstate Highway 29, a major north-south route. Some crushed rock also was produced by contractors for use on the highway system. Ames Sand & Gravel Co., the only commercial operation in the county, produced building and paving gravel.

Divide.—Petroleum was produced from 32 wells in 3 fields and declined 6 percent below that of 1960. Three unsuccessful exploratory wells were completed, and some development drilling was done in the North Tioga field. Baukol-Noonan, Inc., operated the Baukol-Noonan strip coal mine. Coal output was 6 percent below that of 1960. A substantial portion of the production was crushed, and some of it was oil treated. The company also produced miscellaneous clay for the manufacture of lightweight aggregate at its plant at Noonan. Sand and gravel and crushed stone were produced by contractors for the State and county highway departments for road construction and repairs. Susag Sand & Gravel, the only commercial operator in the county, produced paving gravel.

Dunn.—Petroleum production from the Lost Bridge field was 65 percent above that of 1960, the discovery year. One exploratory well was a failure, and no development drilling was done in 1961. Coal production from the Pelton coal mine was 6 percent above that of 1960. Sand and gravel and crushed stone were produced by contractors for the State highway department for road construction.

McHenry.—The first full year's production from the one-well Pratt field, discovered in June 1960, was about 10,000 barrels, a 25-percent increase over that of 1960. Contractors produced sand and gravel for the State highway department for road construction. Great Northern Railway Co. produced gravel for building, railroad ballast, and fill.

McKenzie.—The county ranked second in petroleum output. Production was from 393 wells in 18 fields. Three fields produced from horizons in Devonian and Mississippian formations, and one field, Antelope, produced from three horizons. Amerada Petroleum Corp. completed the No. 3 Bear Den in sec. 36, T. 149 N., R. 96 W., in the Duperow (Devonian) formation. The well flowed 172 barrels of oil a day from a depth of 11,284 to 11,314 feet. This was a new producing horizon in the Bear Den field. New producing horizons in the Duperow formation also were found at the Croff and Keene fields. Amerada Petroleum Corp. completed the No. 1 Anderson-Olson well in sec. 13, T. 149 N., R. 96 W., in the Croff field in September. Initial flow was 132 barrels of oil and 20 barrels of water a day from the Duperow at a depth of 11,652 to 11,664 feet. Total depth of the well was 11,753 feet. This was the first production from Devonian in the Croff field. Production for the year from this horizon was 6,811 barrels of oil.

Texaco Inc. completed the No. 2 Wisness well in sec. 3, T. 152 N., R. 96 W., in November. Initial flow was 211 barrels of oil and 42 barrels of salt water a day from the Duperow formation at a depth of 10,882 to 10,903 feet. Total depth of the well was 11,092 feet. Production for the year was 3,650 barrels of oil. Of 23 development wells completed during the year, 17 were new producers.

Sand and gravel and crushed stone were produced by contractors for the State highway department and by construction and maintenance crews for the county highway department for road construction and repairs.

McLean.—Coal (lignite) production by Burns & Wretling Coal Co., Truax-Traer Coal Co., and Underwood Coal Co. was 9 percent above that of 1960. A substantial portion of the output was crushed, and some of it was oil treated. Sand and gravel was produced by contractors for the State highway department. Lindteigen Construction Co. produced paving gravel.

Mercer.—The county continued to lead in the production of coal (lignite). Knife River Coal Mining Co. operated its Beulah strip mine; The North American Coal Corp., the Indian Head strip mine; Truax-Traer Coal Co., the Dakota Star strip mine; and Reinhart Grishkowsky, the Grishkowsky strip mine. Production was 3 percent above that of 1960, and a portion of the output was treated with a wax or oil-wax spray. Missouri River Sand & Gravel produced building sand and gravel.

Morton.—Coal production by Flemmer Coal Co., Kaelberer Coal Co., Richter Coal Mine, and Timpe & Nilles Coal Co. was 14 percent below that of 1960. Baukal-Noonan, Inc., produced miscellaneous clay for the manufacture of lightweight aggregate. Hebron Brick Co. produced clay for the manufacture of building brick and other heavy clay products. The company also produced a small quantity of bentonite for use in the manufacture of prepared mortars. Helm Bros., Inc., produced building sand and gravel, paving gravel, and fill gravel. Contractors produced sand and gravel for the State and county highway departments for road construction. American Oil Co. (Standard Oil Co. of Indiana) operated its 43,000-barrel-a-day refinery at Mandan. Throughput was 14.9 million barrels, 4 percent above that of 1960. Capacity was increased to 46,000 barrels per day through streamlining of operations and removal of bottlenecks. A 7,500-barrel-a-day Hydrofining unit was added to the plant.

Mountrail.—Petroleum production from 126 wells in 3 fields was 7 percent below that of 1960. That portion of the Tioga field lying within Mountrail County produced 87 percent of the total, and the county retained its rank of fifth in the State in petroleum production. Contractors produced sand and gravel for the State highway department, and Great Northern Railway Co. produced fill gravel.

Renville.—Petroleum production from 56 wells in 3 fields was 53 percent above that of 1960. The first international field in the State was discovered in June when Cardinal Petroleum Co., North American Royalties, Inc., and Sun Oil Co. completed the Aubray Harkness No. 1 in sec. 28, T. 164 N., R. 84 W., in an extension of the Elmore field in Canada. Initial production was 162 barrels of oil a day from the Madison (Mississippian) formation. Two more producers in the North Dakota portion of the field also were completed. Development drilling extended production at the Sherwood field almost to the Canadian border. At the Glenburn field three producers were drilled to the north before a failure in sec. 30, T. 159N., R. 80 W., was abandoned. Three other producers were completed in the western portion, and production limits were apparently established on the north, west, and southeast. Sand and gravel was produced by contractors for the State highway department and the city of Sherwood. Mohall Excavating Co. produced building sand and gravel and fill gravel.

Stark.—Petroleum production from the Heath (Mississippian) formation in the Dickinson field increased fivefold over 1960. Great Western Refining Co. continued to enlarge and improve the Queen City refinery at Dickinson. A gas-oil cracking unit and a Platformer were installed. This was the only asphalt producing plant in North Dakota. Coal (lignite) output, all produced by Dickinson Coal Mining Co. and Walters Coal Mine, was 36 percent above that of 1960. Dickinson Coal Mining Co. operated the Dickinson and Lehigh strip mines. Husky Oil Co. produced barbeque briquets at its Dickinson plant. Dic-Kota Clay Products Co. produced fire clay for the manufacture of heavy clay products. Sand and gravel and crushed stone were produced by contractors for the State highway department, for road construction. Fisher Sand & Gravel Co. produced building, paving, and fill sand and gravel.

Ward.—Ward County ranked second in coal (lignite) production and sand and gravel. Coal output, by Truax-Traer Coal Co. at the Velva strip mine, Sawyer Fuels, Inc., at the Miller strip mine, and Valley Coal Co. at the Valley strip mine, was 24 percent above that of 1960. Contractors produced sand and gravel for the State highway department and construction and maintenance crews produced for the county highway department. Most of this output was used in the construction of Interstate Highway 94. Atlas Sand & Gravel Co. and Minot Sand & Gravel Co. produced building, paving, and fill sand and gravel. Soo Line Railroad Co. and Great Northern Railway Co. produced ballast and fill gravel.

Williams.—Williams County continued to lead in the production of petroleum. The output, from 472 wells in 13 fields, declined slightly from that of 1960. Of considerable significance was the discovery of the Grenora field near the Montana State line. Hunt Oil Co. completed the discovery well in sec. 29, T. 159 N., R. 103 W., in February. The well flowed 179 barrels of oil with 2 percent water from the Madison (Mississippian) limestone at a depth of 7,708 to 7,724 feet. Total depth of the well was 8,210 feet. A confirmation well drilled east and slightly south of the discovery well pumped 41 barrels of oil a day. A third well, one-half mile directly south of the discovery well, flowed 231 barrels of oil a day. At the end of the year a fourth well, nearly 1 mile southwest of the discovery, was nearing completion after flowing 55 barrels of oil in 4 hours. An extension to the north of the discovery was abandoned. Dallea Petroleum Corp. completed the No. 1 Hamlet well in sec. 30, T. 159 N., R. 95 W., in the Northwest McGregor field. The well flowed 439 barrels of oil a day from the Duperow (Devonian) formation at a depth of 10,188 to 10,200 feet. Total depth of the well was 10,300 feet. This was a new producing horizon in the Northwest McGregor field that had previously produced only from the Madison. Westland Oil Co. operated its 3,000-barrel-a-day refinery at Williston. Throughput was 663,000 barrels, a 7-percent increase over that of 1960. A 1,500-barrel-a-day unifining unit was being installed that would provide facilities to process liquid petroleum gases from natural gas plants. Signal Oil and Gas Co. operated its natural gas plant at Tioga. Residue gas was sold to Montana-Dakota Utilities Co. The gas gathering system to serve the plant was extended to the Dimick Lake and Clear Creek fields in McKenzie County through the construction of 15 miles of pipeline. The gathering system extended from the Blue Buttes field in Williams County on the south through the Tioga field in Mountrail County on the north, a distance of 51 miles. Hunt Oil Co. began the construction of a natural gas plant at McGregor; completion was expected early in 1962. The plant was designed to process 6 million cubic feet of oil-well gas a day from the North Tioga and North Tioga Extension fields in Divide and Burke Counties. An average of 7,000 gallons a day of natural gas liquids was expected to be recovered. Butane and propane were to be marketed by a subsidiary of Signal Oil and Gas Co. and some of the natural gasoline recovered as refinery blending stock was to be used by Westland Oil Co. at Minot. Residual gas was to be marketed through pipelines of Montana-Dakota Utilities Co. Ben L. Nelson & Jacob Senti operated the Black Diamond, the only underground coal mine in the State. Production was 18 percent below that of 1960.

Contractors produced sand and gravel and crushed stone for the State and county highway departments, for highway construction and repairs. Building and fill sand and building, paving, and fill gravel were produced by Borsheim Builders Supply Co., George Mockel, Mattson Trucking, and Dale Shubert. Sand and gravel output was nearly three times that of 1960. Dakota Salt and Chemical Co., a wholly owned subsidiary of General Carbon and Chemical Corp. of Lake Forest, Ill., operated its evaporation plant at Williston. This was the first full year of operation since the plant opened in June 1960. Output of salt in 1961 was six times that of 1960. The salt was mined hydraulically through 8,500-foot wells drilled to the Charles formation. Operations in 1960 were through two wells, and a third well was drilled early in 1961. The caverns created by mining the salt were used to store the liquid petroleum gases—butane and propane. For each ton of salt recovered, storage capacity for five barrels of liquid petroleum gases was created.

The Mineral Industry of Ohio

By Joseph Krickich [1] and Roy H. Davis [2]

⁂

VALUE of mineral production in Ohio decreased 6 percent, continuing its decline from the record of 1959. Output of the State's principal mineral commodities was affected by less construction activity and lower production of pig iron and steel. Decreased demand for construction materials (cement, stone, and sand and gravel), refractory materials (fire clay, lime, sandstone, and quartzite), and coal and metallurgical fluxing stone (limestone) was recorded for the year. In contrast with the downward trend of most minerals produced in Ohio, the quantity and value of salt, an important mineral of the State, increased. Ohio continued to rank high nationally in mineral production, leading in clay and lime; it was a significant producer of coal and salt.

TABLE 1.—Mineral production in Ohio [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland ... 376-pound barrels	16,752,121	$58,470	15,302,855	$53,251
Masonry ... 280-pound barrels	978,000	3,008	846,082	2,604
Clays ... thousand short tons	5,165	14,325	4,923	13,790
Coal (bituminous) ... do	33,957	130,877	32,226	121,343
Gem stones	(2)	3	(2)	4
Lime ... thousand short tons	3,117	44,403	3,123	42,158
Natural gas ... million cubic feet	36,074	8,477	36,423	9,069
Peat ... short tons	6,755	93	9,113	123
Petroleum (crude)—thousand 42-gallon barrels	5,405	16,053	[3] 5,161	[3] 15,947
Salt ... thousand short tons	3,108	24,149	3,465	25,037
Sand and gravel ... do	37,943	44,979	33,688	41,272
Stone ... do	[4] 35,856	[4] 59,479	33,652	55,701
Value of items that cannot be disclosed: Abrasive stones, gypsum, dimension limestone (1960), and marl (calcareous) (1960)		1,826		1,566
Total Ohio [5]		[6] 391,150		368,315

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Preliminary figure.
[4] Excludes certain stone; included with "Value of items that cannot be disclosed."
[5] Totals adjusted to eliminate duplicating value of limestone, clays, and calcareous marl used in manufacturing cement and lime.
[6] Revised figure.

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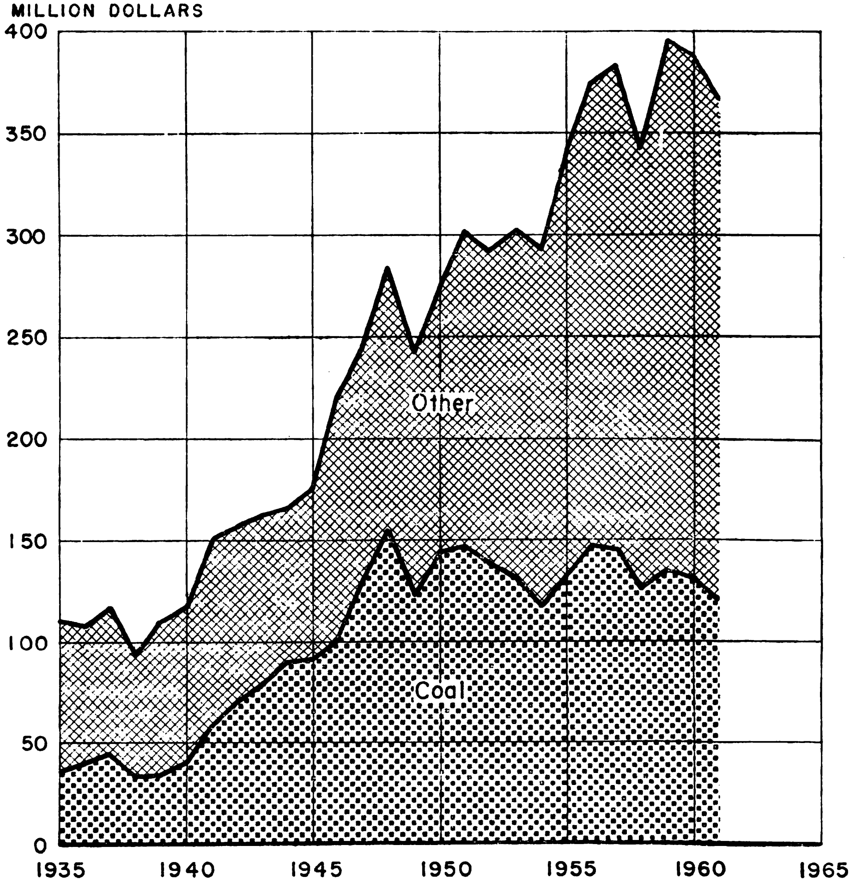

Figure 1.—Value of coal and total value of mineral production in Ohio, 1935–61.

Employment and Injuries.—According to preliminary data, employment in selected mineral industries as shown in table 2 decreased by nearly 5 million man-hours, compared with the 1960 figures. The average number of men working daily decreased, as did man-hours worked for all segments except nonmetal mines. Employment in nonmetal mines increased because of higher salt production and the addition of a new rock salt mine. Injury experience improved slightly, as the overall number of injuries per million man-hours was lowered. Although the number of fatalities increased by one, nonfatal lost-time injuries decreased. In the coal industry the fatality rate per million short tons mined was 0.28, compared with 0.24 in 1960. Of the nine coal mine fatalities, six were at underground mines (three roof falls, two haulage, and one other) and three were at strip mines (two machinery and one other).

Trends and Developments.—The year was highlighted by the initial production of rock salt from a new underground mine at Cleveland. Although construction of the mine was not completed, some salt was

TABLE 2.—Employment and injuries for selected mineral industries[1]

Industry	Men working daily	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:					
Cement	1,972	4,533,286	----------	10	2.21
Clay[2]	670	1,075,686	1	44	41.83
Coal (bituminous)	8,793	15,026,150	8	308	21.03
Coke ovens	2,303	6,674,542	----------	16	2.40
Nonmetal mines[3]	142	288,925	----------	9	31.15
Quarries and mills[4]	4,887	10,894,163	6	183	17.35
Sand and gravel[5]	2,589	4,965,829	1	85	17.32
1961:[6]					
Cement	1,525	3,740,000	----------	6	1.60
Clays[2]	585	940,000	----------	17	18.09
Coal (bituminous)	7,200	14,390,000	9	320	22.86
Coke ovens	1,868	5,305,000	3	11	2.64
Nonmetal mines[3]	251	498,000	----------	7	14.06
Quarries and mills[4]	4,157	9,312,000	4	125	13.85
Sand and gravel[5]	2,604	4,424,000	1	37	8.59

[1] Production employees.
[2] Mines only.
[3] Includes abrasives, gypsum, and salt.
[4] Includes lime plants having no quarry operations.
[5] Commercial producers only.
[6] Preliminary figures.

recovered as development rock during the year. Increased leasing activity and continued high level of wildcat drilling characterized the State's petroleum and natural gas industry. Natural gas companies continued developing underground storage facilities. A 3,000,000-Mcf natural gas storage reservoir in Wayne County was put into operation during the year. Construction started on a new aluminimum sulfate plant at Powhatan Point. The 40,000-ton-per-year plant will recover aluminum sulfate from coal mine wastes. A lightweight aggregate (expanded shale) plant in Perry County discontinued operation because of lack of demand for the material in the area.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Production of grindstones decreased in tonnage but increased in value. Output came from two operations, one each in Lorain and Washington Counties.

Cement.—For the second consecutive year, production, shipments, and value of portland and masonry cements dropped. The number of active plants totaled 10, 1 less than in 1960. In addition, kilns operated at 67 percent of capacity, compared with 72 percent in 1960. Shipments of portland cement decreased 9 percent. Stocks at mills on December 31 were 267,000 barrels less than at the end of 1960. The average unit value for portland cement dropped slightly; average unit value for masonry cement was unchanged. In terms of value, Greene and Lawrence were the leading cement-producing counties.

The principal raw materials used for manufacturing portland cement were cement rock, limestone, shale, and clay. Totals of 4.2 million tons of cement rock and limestone and 648,000 tons of clay and shale were used. In addition, the following tonnages of raw material were used: Gypsum, 120,000; sand and sandstone, 57,000; iron materials, 29,000. Grinding aids and air-entraining compounds also were used. Types I–II (general use), type II (high-early-strength), and waterproof portland cements were produced.

Finished portland cement was delivered to consumers in Ohio (72 percent), Indiana (11 percent), West Virginia (8 percent), and Illinois, Kentucky, Michigan, Minnesota, Pennsylvania, Virginia, and Wisconsin. Distribution of portland cement shipments by use was as follows: 9.1 million barrels to ready-mixed concrete companies, 2.4 million barrels to highway and other contractors, 2.3 million barrels to concrete manufacturers, 1.5 million barrels to building material dealers. The remainder was shipped to Federal, State, and local government agencies and other miscellaneous customers. Of the total, 84 percent was shipped by truck; the remainder, by rail. Most of the portland cement was shipped in bulk; only 11 percent was shipped in containers, mainly paper bags.

Annual finished-cement capacity on December 31 was 22.4 million barrels, 1.1 million barrels less than in 1960. Of the total capacity, 15.5 million barrels was by the wet process; the remainder was by the dry process. The cement industry consumed 379.5 million kilowatts of electrical energy, 35.5 million kilowatts less than in 1960. Fifty-nine percent of the electrical energy was purchased from public utilities, compared with 53 percent in 1960.

Late in 1960, Medusa Portland Cement Co. permanently closed its Bay Bridge (Erie County) plant because of obsolete equipment and depletion of raw materials. During 1961, the company made shipments of finished portland cement from stocks and converted its storage silos to a distribution facility. Diamond Portland Cement Co., Division of The Flintkote Co., began constructing a 9,000-barrel bulk-cement-loading facility at Cleveland. Cement was to be delivered from the company Middle Branch (Stark County) plant. Columbia Cement Corp. began constructing a 10,000-barrel bulk-distributing facility in the Cincinnati area. Cement was to be shipped in bulk by rail from the company plant at Zanesville (Muskingum County).

TABLE 3.—Finished portland cement produced, shipped, and in stock

(Thousand barrels and thousand dollars)

Year	Number of active plants	Production	Shipment from mills		Stocks at mills Dec. 31
			Quantity	Value	
1952–56 (average)	9	13,361	13,224	$36,672	924
1957	10	16,291	15,454	49,115	1,974
1958	10	15,191	14,960	50,092	2,115
1959	11	18,028	18,141	60,560	1,938
1960	11	16,850	16,752	58,470	1,962
1961	10	15,059	15,303	53,251	1,695

Clays.—Ohio continued to lead in clay production. Total output declined, primarily owing to decreased demand for clays for heavy clay products, refractories, and cement. Clays for refractory materials used by the steel, glass, and foundry industries decreased 9 percent; clay for cement manufacture declined 7 percent; and clay for heavy clay products declined 3 percent. Clays for these three main uses furnished 93 percent of the total output. Fifty-four percent of the total was miscellaneous clay or shale. The remainder was fire clay, used principally in heavy clay products and refractories. Of the 18 fire-clay-producing counties, Tuscarawas and Stark Counties led in output. Cuyahoga and Stark Counties led in production among the 41 miscellaneous clay-producing counties.

TABLE 4.—Clays sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Carroll	(1)	(1)	68,801	$148,185
Columbiana	310,115	(1)	318,311	(1)
Coshocton	----------	----------	1,500	1,875
Cuyahoga	312,503	$281,890	364,726	356,112
Delaware	51,207	73,032	57,431	84,077
Gallia	2,030	3,857	7,086	12,046
Hocking	37,856	126,848	34,372	106,729
Holmes	105,367	320,614	85,595	(1)
Huron	144	288	----------	----------
Jackson	121,667	(1)	98,597	(1)
Jefferson	142,179	940,211	127,067	819,121
Lawrence	224,667	987,410	179,055	749,272
Madison	1,050	1,050	(1)	(1)
Marion	135,340	169,260	116,070	145,088
Muskingum	(1)	119,041	(1)	109,536
Paulding	(1)	126,217	(1)	(1)
Perry	344,520	832,613	269,673	732,843
Putnam	26,694	30,568	25,607	29,584
Scioto	11,088	47,737	(1)	53,567
Seneca	25,000	30,000	19,500	24,000
Stark	654,852	1,734,064	699,183	1,970,948
Summit	109,411	173,096	109,325	123,804
Tuscarawas	988,556	3,184,507	921,912	3,017,789
Van Wert	7,340	12,790	1,780	1,780
Vinton	32,383	131,778	(1)	(1)
Wayne	(1)	(1)	103,245	94,334
Undistributed [2]	1,520,731	4,998,159	1,314,452	5,209,332
Total	5,164,700	14,325,030	4,923,288	13,790,022

[1] Figure withheld to avoid disclosing individual company confidential data.

[2] Includes data for the following counties: Ashland, Athens, Auglaize, Darke, Erie (1960), Franklin, Greene, Hancock, Harrison, Henry, Highland, Lake, Lucas, Mahoning, Medina, Noble, Portage, Richland, Williams, Wood, and Wyandot; and data indicated by footnote 1.

Gem Stones.—Value of gem stones (mineral specimens) was higher than in 1960. Materials recovered included calcite, celestite, flint, fluorite, fossils, and selenite. Lucas, Ottawa, and Wood Counties were the areas attracting the greatest mineralogical interest. Most of the specimens were collected by members of mineral and lapidary clubs.

Gypsum.—Tonnage and value of crude gypsum continued to decline. Production from two mines in Ottawa County was calcined at nearby company plants for use in manufacturing building products. In addition, gypsum from outside the State was calcined at a plant in Lorain County. Production of calcined gypsum was 4 percent lower than in 1960 and totaled 287,000 tons valued at $4.2 million.

Iron Oxide Pigments.—Red iron oxide pigments were produced at Coplay (Summit County) by Minnesota Mining & Manufacturing Co. Principal raw material was pyrite cinder shipped from Delaware.

Lime.—Ohio continued to lead in tonnage and value of lime produced. The quantity was about the same as in 1960, but the value declined 5 percent. The decreased value was attributed primarily to lower unit values for all major categories of lime. Demand decreased for building and refractory lime used by the construction and steel industries, respectively. Demand for lime for chemical and industrial applications increased; output of agricultural lime decreased for the eighth consecutive year. Lime was produced in 14 counties (12 in 1960). Eighty-five percent of the total output was quicklime; the remainder was hydrated lime used chiefly by the construction industry. Sandusky County continued to lead in lime production, furnishing 29 of the quantity and 34 percent of the value. Shaft kilns and continuous hydrators predominated at the reporting lime plants. Fuels used at the plants included anthracite, bituminous coal, coke, natural gas, producer gas, and carbon monoxide. Shipments of lime were made to consumers in the District of Columbia and all States except Alaska, Hawaii, Oregon, and Idaho. Exports were made chiefly to Canada, Chile, and Mexico, with lesser quantities to Puerto Rico and South Viet-Nam.

TABLE 5.—Lime sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Year	Agricultural (burned)		Building		Chemical and other industrial		Refractory		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	51	$646	574	$8,880	885	$7,813	1,237	$17,730	2,747	$35,069
1957	35	482	510	9,049	918	8,411	1,300	20,441	2,763	38,383
1958	34	481	474	7,539	1,007	9,977	896	14,474	2,411	32,471
1959	31	427	492	9,249	1,563	17,484	1,104	17,961	3,190	45,121
1960	30	449	426	8,288	1,604	18,516	1,057	17,150	3,117	44,403
1961	27	381	399	7,400	1,690	18,756	1,007	15,621	3,123	42.158

Perlite (Expanded).—Expanded perlite was produced at plants in Cuyahoga and Hamilton Counties from crude material shipped from Western States. The Akron (Summit County) plant of J. P. Loomis Concrete & Supply Co. discontinued production at the end of 1960.

Salt.—For the second consecutive year, output of salt in Ohio exceeded 3 million tons and established a new record. Production increased 11 percent, mainly because of increased output of rock salt and brine. Evaporated salt production, which decreased, was sold for a wide variety of uses; some evaporated salt was marketed as pressed blocks. Brine was recovered from wells and used by producers, mainly for manufacturing chlorine and soda ash. Rock salt was used chiefly for chemicals and for controlling ice on highways. At yearend, a limited quantity of rock salt was recovered as development ore at the Cleveland mine of International Salt Co. The underground mine was still in the development stage but was expected to be fully operational in 1963. Salt-producing counties in decreasing order of output, were Lake, Summit, Wayne, Cuyahoga, and Meigs.

Sand and Gravel.—The sand and gravel industry was characterized by less demand for structural and paving material, reflecting decreased construction activity. Total tonnage, including Government-and-contractor operations, was 11 percent below the 1960 figure. Commercial sand and gravel consumed in building and highway construction totaled 27.9 million tons, 7 percent less than in 1960. In addition, demand for industrial sand decreased; production totaled 999,000 tons valued at $3.7 million. Major industrial sand uses included molding, glass making, and sand for furnace construction and repair.

A total of 361 commercial operations were active, 4 more than in 1960. Two operations produced over 1 million tons; 3 operations produced from 500,000 to 1 million tons. Ninety-three percent of the commercial production was washed, screened, or otherwise prepared. Over 29.8 million tons of sand and gravel was shipped to consumers by truck; 1.8 million tons was shipped by rail; and over 900,000 tons was shipped by water and other means. Output of sand and gravel was reported in 70 counties; Hamilton, Franklin, and Montgomery Counties led with production exceeding 3 million tons each. Butler, Portage, and Stark Counties also were important areas for sand and gravel production.

TABLE 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,410	$7,252	5,773	$6,427
Paving	6,654	6,989	6,198	6,363
Fill	793	629	778	649
Molding	(1)	(1)	341	1,269
Filtration	(1)	(1)	13	43
Railroad ballast	1	1	----------	----------
Fire or furnace	(1)	(1)	162	398
Other [2]	1,249	4,203	602	2,055
Gravel:				
Building	5,369	6,782	5,265	6,597
Paving	11,691	13,774	10,679	13,038
Railroad ballast	162	125	53	39
Fill	628	417	716	588
Other	2,133	3,037	1,956	2,711
Total sand and gravel	35,090	43,209	32,536	40,177
Government-and-contractor operations:				
Sand:				
Building	25	34	----------	----------
Paving	341	364	468	468
Fill	----------	----------	31	32
Gravel:				
Building	379	341	2	2
Paving	572	479	649	593
Fill	1,536	553	----------	----------
Other	----------	----------	2	(3)
Total sand and gravel	2,853	1,770	1,152	1,094
Grand total	37,943	44,979	33,688	41,272

[1] Figures withheld to avoid disclosing individual company confidential data.

[2] Includes the following sands: glass, grinding and polishing, blast, fire or furance (1960), engine, ferrosilicon, ground, and other; and data indicated by footnote 1.

[3] Less than $1,000.

Slag (Iron-Blast-Furnace).—Ohio continued to rank second among the 16 slag-processing States and furnished 16 percent of the national output. Production of processed iron-blast-furnace slag decreased from 6.4 million tons in 1960 to 4.2 million tons. Value decreased 34 percent and totaled $8.2 million. Eighty percent (84 percent in 1960) of the total processed slag was screened, air-cooled slag; the remainder consisted of granulated and lightweight (expanded) slag. Screened, air-cooled slag was used chiefly as an aggregate in concrete construction, in bituminous construction of various types, in highway and airport construction, and as railroad ballast.

Stone.—Tonnage and value of stone output decreased, primarily because of less demand for limestone for aggregate and sandstone for architectural and refractory applications. Output of calcareous marl for agstone in Darke County decreased. Stone was produced in 65 counties, compared with 63 counties in 1960. Limestone furnished 98 and 86 percent of the total stone tonnage and value, respectively. Of 57 limestone-producing counties, Sandusky, Erie, and Seneca, in order of decreasing tonnage, were the leading counties. Sandstone was marketed as both dimension and crushed stone. Output of dimension sandstone, used mainly for sawed and dressed architectural stone, declined. Quantities of sawed and rough architectural stone also were used as refractories in lining steel furnaces. Lorain County led the 14 producing counties in output of sandstone; Scioto County led in value.

TABLE 7.—Crushed and broken limestone sold or used by producers, by uses

Use	1960		1961	
	Short tons	Value	Short tons	Value
Riprap	[1] 110,977	[1] $138,555	121,101	$168,841
Concrete aggregate and roadstone	17,255,250	22,473,417	16,700,520	21,680,840
Fluxing stone	[1] 4,866,192	[1] 7,498,200	4,432,666	6,807,105
Agriculture	2,242,483	3,818,393	1,987,540	3,478,042
Railroad ballast	1,051,591	1,279,700	900,359	1,124,409
Miscellaneous uses	9,602,303	16,043,837	8,956,218	14,664,629
Total	35,128,796	51,252,102	33,098,404	47,923,866

[1] Revised figure.

Sulfur (Recovered Elemental).—Elemental sulfur was recovered by catalytic oxidation of hydrogen sulfide at the Toledo refinery of Sun Oil Co.

Vermiculite (Exfoliated).—Cleveland Builders Supply Co. produced exfoliated vermiculite at Cleveland from crude material shipped from Montana and the Union of South Africa. On January 1, the company acquired and began operating the plant formerly owned by Archer-Daniels-Midland Co., Federal Foundry Supply Division. Exfoliated vermiculite was used for concrete and plaster aggregate, soil conditioner, loose fill insulation, and other uses.

MINERAL FUELS

Coal (Bituminous).—For the second consecutive year, production of bituminous coal decreased; tonnage dropped 5 percent and was 1.7

million tons less than in 1960. The average value per ton ($3.77) was 2 percent below that in 1960. A total of 439 mines producing 1,000 tons or more were active, 31 less than in 1960. The number of active strip mines totaled 260, 5 less than in 1960; underground mines dropped from 149 to 126; and auger mines dropped from 56 to 53. Seventy percent of the State coal output came from strip mines; the remainder came from underground (26 percent) and auger (4 percent) mines.

Strip-mine production totaled 22.5 million tons, 6 percent less than in 1960. The leading stripping areas were Harrison, Morgan, and Jefferson Counties, which accounted for 41 percent of the strip-mine production. The average value of strip-mine coal dropped from $3.64 in 1960 to $3.57. Coal was stripped and loaded using electric, diesel-electric, diesel, and gasoline powered shovels and dragline excavators. Sixty-five percent of the powered shovels and draglines had dipper capacities of less than 3 cubic yards; 13 had capacities over 12 cubic yards.

Coal from underground mines was recovered in 18 counties; production decreased 8 percent. Seventy-five percent of the underground tonnage was produced in Belmont and Harrison Counties. The average value per ton of underground coal dropped from $4.49 to $4.39. Almost the entire underground output was cut by machines (63 percent by cutting machines and 36 percent by continuous-mining machines). Thirty-five continuous-mining machines were in operation, compared with 38 in 1960. Tonnage of coal cut by continuous-mining machines increased 3 percent and totaled 3.1 million tons. Ninety-two percent of the underground production was mechanically loaded.

Recovery of coal by auger mining increased 44 percent and totaled 1.3 million tons. Production was reported in 18 counties, compared with 16 counties in 1960. The average value per ton increased to $3.12, compared with $3.10 in 1960. Jefferson and Coshocton Counties furnished 41 percent of the auger-mined tonnage.

Over 14.5 million tons of coal was cleaned at 21 preparation plants (1 less than in 1960). Of the tons of coal cleaned, 47 percent was by jigs, 52 percent was by wet-washing other than jigs, and 1 percent was by pneumatic methods. Over 3.7 million tons of coal was treated with antifreezing and dust-allaying materials, mainly oil and calcium chloride. Thirty-seven percent of the coal was crushed before being shipped to consumers. Rail or water shipments to consumers totaled 16.3 million tons; shipments by truck totaled 11.5 million tons. The remainder was shipped by other means, mainly pipeline. Coal produced by captive operations increased and totaled 4.5 million tons.

TABLE 8.—Bituminous coal production

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	36,043	133,910	1959	35,112	135,729
1957	36,862	146,134	1960	33,957	130,877
1958	32,028	126,241	1961	32,226	121,343

Coke and Coal Chemicals.—Ohio dropped from second in 1960 to third among the 20 oven-coke-producing States. Production of coke totaled 6.7 million tons valued at $112.9 million, decreases of 20 in tonnage and 21 percent in value compared with 1960. The average value per ton, which decreased from $16.87 in 1960 to $16.84, was still below the national average of $17.80. Yield of coke from coal was 70.01 percent, compared with 71.75 percent in 1960.

Coal produced in Kentucky, Pennsylvania, Virginia, and West Virginia was used at oven-coke plants in Ohio. Of the total, 4.6 million tons came from West Virginia, 3.5 million tons from Pennsylvania, 521,000 from Kentucky, and 632,000 tons from Virginia. Seventy-five percent of the coal received was high volatile, 23 percent was low volatile, and 2 percent was medium volatile. Ninety percent of the coke produced was consumed by producing companies, largely in blast furnaces; the remainder represented commercial sales to blast furnaces, foundries, and other industrial consumers, and for residential heating.

Production of coke breeze, the small sizes resulting from screening run-of-oven coke totaled 439,000 tons valued at $3.3 million and was used mostly by the producing companies in steam plants and agglomerating plants, and for other industrial uses. A total of 95.8 billion cubic feet of coke-oven gas was produced; 41 percent was used in heating ovens, 58 percent was surplus used or sold, and the remainder was wasted. Twelve plants produced coke-oven ammonia, totaling 85,000 short tons of sulfate equivalent. Over 82.1 million gallons of coke-oven tar was produced; 70.6 million gallons was sold for refining into tar products, and the remainder was used by producers for refining or topping and as fuel. Crude light oil recovered at 12 plants totaled 26.3 million gallons, from which 12.9 million gallons of benzene, 2.9 million gallons of toluene, 1.1 million gallons of xylene, and 430,000 gallons of solvent naphtha were derived.

Fuel Briquets and Packaged Fuel.—Consumption of fuel briquets totaled 33,000 tons, 21 percent less than in 1960. Five plants produced packaged fuel; production totaled 1,491 short tons valued at $33,000. The average value per ton increased, but was still below the national average of $23.24. Packaged fuel producers in Ohio furnished 8 percent of the national total.

Peat.—Tonnage and value of peat increased, mainly because of an increase in the number of active operations to 15 from 13 in 1960. Eighty-six percent of the output was sold in bulk (85 percent in 1960); the remainder was sold in packages. Peat consumption totaled 46,000 tons, 42 percent greater than in 1960. Among the 10 peat-producing counties (8 in 1960), Wyandot and Franklin Counties led in value of production.

Petroleum and Natural Gas.—Increased leasing activity and increased drilling characterized the oil and gas industry. Total well completions increased from 1,099 to 1,131 (including 565 oil wells, 194 gas wells, 290 dry holes, and 82 service wells). Development completions totaled 1,078, 34 more than in 1960; wildcat completions dropped from 55 to 53. Among the 42 counties reporting development drilling, Hocking, Ashland, and Wayne Counties were the leaders. Wildcat drilling was reported in 30 counties; Portage (5 wells), Medina (4 wells), and Morrow (4 wells) were the principal drilling areas. Of the total well completions, 86 percent were drilled with cable tools, well above the national average of 19 percent.[3]

According to the American Gas Association and American Petroleum Institute, proved reserves, December 31, were: Natural gas, 733,837 million cubic feet (14.65 psia, at 60°F); and crude petroleum, 75.7 million barrels. Petroleum reserves increased by 1.1 million barrels; natural gas reserves decreased by 31,716 million cubic feet. Gas storage facilities were maintained by 3 companies at 15 locations in the State, according to a survey.[4] The companies were East Ohio Gas Co. (4 areas), Manufacturers Light and Heat Co. (1 area), and Ohio Fuel Gas Co. (10 areas). Total storage capacity of Ohio natural gas reservoirs was 368.2 billion cubic feet, of which 198.2 billion was working gas capacity and 170 billion cubic feet was required as cushion gas.

Ten petroleum refineries and cracking plants were active; crude oil capacity increased and totaled 439,000 barrels per day. Gasoline capacity was 173,000 barrels per day, compared with 177,000 barrels in 1960. Active refineries were at Canton, Cincinnati, Cleveland, Cleves, Lima, Newark, and Toledo.

METALS

Aluminum.—Primary aluminum was produced at Omal near Clarington (Monroe County) by Ormet Corp., owned jointly by Olin Mathieson Chemical Corp. and Revere Copper & Brass, Inc. Tonnage was greater than in 1960, but total value declined. The company reduced alumina produced at its Burnside, La., plant, which processed bauxite imported from Surinam. Annual capacity of the Omal reduction plant remained at 180,000 tons. During the year, Olin Mathieson announced plans for expanding its aluminum-rolling mill adjacent to the reduction plant. Included among the new facilities under the expansion program were a 66-inch cold-rolling mill for producing bright finished sheet, additional ingot-heating facilities, new automatic shears, auxiliary plate sawing, and flattening and inspection equipment. The new facilities were scheduled for completion by the end of 1962.

In March, North American Coal Corp. began constructing a $1 million plant for producing aluminum sulfate from coal mine waste at Powhatan Point. The 40,000-ton-per-year plant was to use a new process developed in cooperation with Strategic Materials Corp., Niagara Falls, N.Y. Some 10 million tons of ore previously considered waste was available on sites adjoining the new plant. The company was also designing a plant to convert aluminum sulfate to alumina (aluminum oxide) which could be used for production of primary aluminum metal. Production of aluminum sulfate was scheduled for early 1962.

Beryllium.—The Brush Beryllium Corp. processed beryl to produce beryllium metal, alloys, and compounds. Sales of the company totaled $26 million, compared with $28.8 million in 1960. The fourth year elapsed of the 5-year contract awarded the company for annual delivery of 37,500 pounds of nuclear-grade beryllium to the U.S. Atomic Energy Commission. During the year the company completed construction of a $3 million plant at Cleveland to finish, fabricate, and machine beryllium metal. The company also announced plans to expand metal production capacity at Elmore to more than 30,000 pounds per month from the present 12,000-pound level. The increase was part of a $6 million expansion initiated by the company in 1960. Beryl also was consumed at Lisbon by Delta Star Electric Division, H. K. Porter Co., which used the material for high-voltage suspension insulators.

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[3] Oil and Gas Journal, v. 60, No. 5, Jan. 29, 1962.

[4] Bizal, Robert B. Gas-Storage Capacity Spurts. Oil and Gas J., v. 16, No. 20, May 14, 1962, pp. 125–138.

Ferroalloys.—Among the 19 ferroalloy-producing States, Ohio continued as the leading producer, supplying 25 percent of the national output. Production totaled 472,000 tons, 24 percent less than in 1960. However, shipments decreased only 2 percent in tonnage to 544,000 tons and increased 10 percent in value to $134.7 million. The higher value was due primarily to increased shipments of ferrochromium and chromium briquets and ferrosilicon. In addition, higher unit values were recorded for ferromanganese and ferrosilicon. These ferroalloys plus silvery pig iron and silicomanganese represented 97 percent of the tonnage and 92 percent of the value of all ferroalloys shipped.

TABLE 9.—Ferroalloy producers in 1961

Company	Location	Type of furnace	Ferroalloys produced[1]
Interlake Iron Corp.	Beverly	Electric	SiMn, FeSi, FeCr.
Jackson Iron & Steel Co.	do	Blast	Silvery pig iron.
Ohio Ferro-Alloys Corp.	Brilliant	Electric	FeSi, FeCr.
Do	Philo	do	FeMn, SiMn, FeSi, other miscellaneous ferroalloys.
Do	Powhatan Point	do	FeSi, Si.
Union Carbide Metals Co.	Marietta	do	FeMn, SiMn, FeSi, FeCr, spiegeleisen, other miscellaneous ferroalloys.
Do	Ashtabula	do	FeMn, SiMn, FeSi.
Vanadium Corporation of America.	Vancoram	do	FeCr, FeSi.
Do	Cambridge	do	FeMn, FeTi, FeV, FeB, FeCb, other miscellaneous ferroalloys.

[1] Symbols used: FeMn, ferromanganese; SiMn, silicomanganese; FeSi, ferrosilicon; FeCr, ferrochromium; FeTi, ferrotitanium; FeB, ferroboron; FeCb, ferrocolumbium; FeV, ferrovanadium; Si, silicon.

Iron and Steel.—Pig iron production totaled 11 million tons, 7 percent less than in 1960. Shipments decreased 5 percent and totaled 11 million tons valued at $669 million. Yearend stocks were lower than in 1960. Basic, bessemer, foundry, low-phosphorous, malleable, and direct-casting types of pig iron were produced. Pig iron was produced at 17 plants having 46 blast furnaces. The Lowellville plant of Sharon Steel Corp. and the Hubbard plant of Youngstown Sheet & Tube Co. were idle in 1961. In June, Valley Mould & Iron Corp. purchased the Hubbard plant from Youngstown but did not operate it. More basic and bessemer pig iron was produced than other classes; basic pig iron represented 82 percent of the total. Consumption in blast furnaces included 7 million tons of domestic iron ore, 1.7 million tons of foreign iron ore, 2.8 million tons of limestone and dolomite, 589,000 tons of mill cinder and roll scale, 553,000 tons of open-hearth and bessemer slag, 8.1 million tons of coke, 8,000 tons of pig iron, 682,000 tons of home and purchased scrap, 148,000 tons of slag scrap, and 4.2 million tons of sinter. In addition, domestic and foreign manganiferous ore, flue dust, coke breeze, pellets, nodules, and other miscellaneous materials were consumed in producing pig iron. A total of 1.5 million tons of domestic iron ore, 1.5 million tons of foreign iron ore, 1.1 million tons of flue dust, and quantities of limestone and dolomite, mill cinder and roll scale, coke breeze, and anthracite were consumed in agglomerating plants to produce sinter and self-fluxing agglomerates.

Lead and Zinc Pigments.—Willard Storage Battery Co. manufactured black lead oxide pigments at Cleveland. Also at Cleveland, E. I. du Pont de Nemours & Co., Inc., manufactured zinc chloride pigments. American Zinc Oxide Co. produced zinc oxide at Columbus.

Titanium.—Reactive Metals, Inc., Ashtabula, produced titanium sponge by sodium reduction of titanium tetrachloride. Republic Steel Corp., at Massillon and Canton, and Reactive Metals, Inc., at Niles, melted titanium. Titanium Metals Corp. of America, Toronto, and Reactive Metals, Inc., Niles, rolled and fabricated titanium metal. Titanium Metals Corp. of America announced plans to expand its Toronto plant by constructing a $2 million facility to produce seamless, welded, and redrawn titanium tubing. The facility was scheduled for operation early in 1962.

Zirconium.—Reactive Metals, Inc., produced hafnium-free zirconium sponge at Ashtabula and zirconium ingot at Niles. Zircon and zirconia refractories were produced at Cincinnati by Chas. Taylor Sons Co. During the year Hawshaw Chemical Co. began production of high-purity zirconium oxide at new facilities at Elyria. Zirconium ferroalloys were produced by Union Carbide Metals Co. at Ashtabula and Vanadium Corporation of America at Cambridge.

REVIEW BY COUNTIES

Increased values were reported in 29 of the 87 mineral-producing counties. Decreased values were recorded for most of the coal-producing counties in the eastern part of the State. Fulton County continued as the only county from which no mineral production was reported. In decreasing order of value, Harrison and Belmont Counties continued as the leading mineral-producing counties. Lake County replaced Greene County as the third-ranking county. Mineral production exceeding $10 million was reported for seven other counties. In addition, 35 counties had values over $1 million. Sand and gravel was produced by Government-and-contractor operations in 15 counties. Petroleum and natural gas operations were excluded from the county review section because detailed data were not available.

Adams.—Limestone was mined at the Plum Run quarry near Peebles by Davon, Inc. Stone was prepared for use as concrete aggregate, roadstone, blast-furnace flux, agstone, and railroad ballast, and in manufacturing cement. Finely ground limestone was sold for coal mine dusting. Limestone for road construction and maintenance was mined by the Adams County road crew.

TABLE 10.—Value of mineral production in Ohio, by counties [1] [2]

County	1960	1961	Minerals produced in 1961 in order of value
Adams	$589,817	$581,040	Stone.
Allen	767,802	916,915	Stone, sand and gravel.
Ashland	(3)	(3)	Sand and gravel, clay.
Ashtabula	(3)	(3)	Lime, sand and gravel.
Athens	2,160,416	1,961,192	Coal, stone, clay, sand and gravel.
Auglaize	(3)	(3)	Stone, sand and gravel, clay.
Belmont	(3)	(3)	Coal, stone.
Brown	42,243	42,439	Stone, sand and gravel.
Butler	3,311,573	2,416,545	Sand and gravel.
Carroll	1,907,670	1,964,036	Coal, clay, stone, sand and gravel.
Champaign	336,943	296,262	Sand and gravel.
Clark	(3)	(3)	Sand and gravel, lime, stone.
Clermont	720,555	564,674	Sand and gravel, stone.
Clinton	666,439	615,690	Stone, sand and gravel.
Columbiana	7,754,903	6,424,785	Coal, clay, sand and gravel.
Coshocton	8,703,319	9,351,327	Coal, stone, sand and gravel, clay.
Crawford	(3)	(3)	Stone, sand and gravel.
Cuyahoga	1,298,182	2,480,534	Sand and gravel, lime, clay, salt.
Darke	(3)	(3)	Sand and gravel, clay, peat, stone.
Defiance	(3)	(3)	Sand and gravel.
Delaware	1,463,252	988,790	Stone, lime, clay.
Erie	4,609,124	3,392,817	Stone, cement, sand and gravel.
Fairfield	345,932	342,390	Sand and gravel.
Fayette	914,242	738,510	Stone.
Franklin	8,339,263	7,357,769	Sand and gravel, stone, lime, clay, peat.
Gallia	3,498,991	2,673,967	Coal, sand and gravel, stone, clay.
Geauga	(3)	(3)	Sand and gravel, stone.
Greene	(3)	(3)	Cement, sand and gravel, stone, clay.
Guernsey	1,077,929	939,853	Coal, stone.
Hamilton	5,814,598	5,372,322	Sand and gravel, stone.
Hancock	(3)	(3)	Stone, clay, sand and gravel, lime.
Hardin	(3)	(3)	Stone.
Harrison	31,743,348	30,923,621	Coal, stone, clay.
Henry	(3)	(3)	Sand and gravel, clay, gem stones.
Highland	(3)	(3)	Stone, sand and gravel, clay.
Hocking	468,464	319,551	Coal, clay, sand and gravel, gem stones.
Holmes	1,086,580	1,200,802	Coal, stone, clay, sand and gravel.
Huron	(3)	(3)	Sand and gravel, peat.
Jackson	2,567,699	1,936,054	Coal, clay, stone.
Jefferson	13,960,503	12,113,369	Do.
Knox	(3)	(3)	Sand and gravel, stone.
Lake	(3)	(3)	Salt, cement, lime, sand and gravel, clay, stone.
Lawrence	10,564,390	10,301,004	Cement, coal, clay, stone, sand and gravel.
Licking	662,391	661,538	Sand and gravel, gem stones.
Logan	310,917	398,832	Stone, sand and gravel, peat.
Loraine	(3)	(3)	Stone, sand and gravel, abrasives.
Lucas	(3)	(3)	Cement, stone, sand and gravel, clay, gem stones.
Madison	(3)	(3)	Sand and gravel, stone, clay.
Mahoning	(3)	(3)	Coal, stone, clay, sand and gravel, peat.
Marion	(3)	(3)	Stone, sand and gravel, clay.
Medina	(3)	(3)	Sand and gravel, clay.
Meigs	(3)	(3)	Sand and gravel, coal, salt.
Mercer	(3)	(3)	Stone.
Miami	(3)	(3)	Stone, sand and gravel, peat.
Monroe	(3)	213,722	Sand and gravel.
Montgomery	4,057,432	4,359,182	Sand and gravel, stone, lime.
Morgan	(3)	(3)	Coal, sand and gravel, stone.
Morrow	129,100	64,900	Sand and gravel.
Muskingum	(3)	(3)	Cement, stone, sand and gravel, coal, clay.
Noble	(3)	(3)	Coal, stone, clay.
Ottawa	7,764,195	6,259,251	Lime, stone, gypsum, gem stones.
Paulding	(3)	(3)	Cement, stone, clay.
Perry	(3)	(3)	Coal, sand and gravel, clay, stone.
Pickaway	(3)	(3)	Sand and gravel.
Pike	(3)	715,660	Sand and gravel, stone.
Portage	4,438,268	3,481,249	Sand and gravel, stone, coal, clay, peat.
Preble	(3)	(3)	Lime, sand and gravel, stone.
Putnam	415,804	399,105	Stone, clay.
Richland	(3)	(3)	Sand and gravel, clay, peat.
Ross	841,654	(3)	Lime, sand and gravel, stone.
Sandusky	17,019,936	16,621,513	Lime, stone, sand and gravel, gem stones
Scioto	(3)	(3)	Stone, clay, sand and gravel.
Seneca	(3)	(3)	Lime, stone, clay.
Shelby	426,504	552,615	Sand and gravel, stone.

See footnotes at end of table.

TABLE 10.—Value of mineral production in Ohio, by counties[1] [2]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Stark	$10,767,157	$12,069,555	Cement, coal, clay, sand and gravel, stone, peat, gem stones.
Summit	(3)	(3)	Salt, cement, lime, sand and gravel, stone, clay, gem stones.
Trumbull	246,840	209,453	Sand and gravel.
Tuscarawas	13,056,405	12,202,852	Coal, clay, sand and gravel, stone.
Union	(3)	(3)	Stone, sand and gravel.
Van Wert	(3)	(3)	Stone, clay.
Vinton	1,226,809	807,117	Coal, clay, stone.
Warren	689,971	733,358	Sand and gravel.
Washington	(3)	(3)	Coal, sand and gravel, abrasives.
Wayne	(3)	(3)	Salt, stone, sand and gravel, coal, clay.
Williams	(3)	(3)	Sand and gravel, clay.
Wood	(3)	(3)	Stone, clay, gem stones.
Wyandot	(3)	(3)	Stone, lime, sand and gravel, peat, clay.
Undistributed [4]	[5] 214,383,150	202,349,363	
Total	[5] 391,150,000	368,315,000	

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[1] Fulton County not listed as no production was reported.

[2] Natural gas and petroleum not listed by counties as data are not available; included with "Undistributed."

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[4] Includes natural gas and petroleum, some gem stones, and sand and gravel that cannot be assigned to specific counties, and values indicated by footnote 3.

[5] Revised figure.

Allen.—Limestone was mined at Lima by Western Ohio Stone Co. and National Lime & Stone Co., at Delphos by Suever Stone Co., and at Bluffton by Bluffton Stone Co. Sand and gravel for building and paving was produced by Wapak Sand & Gravel Co. at its No. 6 pit near South Westminster.

Ashland.—Young's Sand & Gravel Co., Loudonville, Bolin & Sons, Ashland, and Charles Bucklew, West Salem, produced commercial sand and gravel for paving and building. Shale mined by E. Biglow Co. near New London was used in manufacturing heavy clay products.

Ashtabula.—Production of sand and gravel was reported by five companies. Most of the output was used in building construction and highways. The largest producer was Northeast Materials, Inc., at Kingsville. Lime was produced for metallurgical and chemical uses.

Athens.—Coal production was 13 percent lower than in 1960; 15 mines (11 underground, 2 strip, and 2 auger) were active, compared with 14 mines (12 underground and 2 strip) in 1960. Gem Coal Co. cleaned coal by wet washing at its No. 255 preparation plant. Crushed limestone was produced by Shamrock Quarries, Inc., and Diamond Stone Quarries, Inc., both near Albany, and Ball & Ball near Amesville. Natco Corp. mined plastic fire clay from pits near Nelsonville and Haydenville for manufacturing building brick and heavy clay products. Athens Building & Material Co., Athens; Slater Sand & Gravel Co., The Plains; and F. H. Brewer Co., Inc., Chauncey, produced construction sand and gravel, each using fixed plants.

Auglaize.—National Lime & Stone Co. produced limestone for concrete aggregate, railroad ballast, and agstone at its Buckland quarry. Three stationary plants and one portable plant produced construction sand and gravel. Producers were Quality Sand & Gravel & Ready-

Mix Co., Wapack Sand & Gravel Co., and Western Ohio Stone Co. operating near Wapakoneta and Jackson Center Gravel Co. near Jackson Center. Sandkuhl Tile Co. mined clay near Spencerville.

Belmont.—Belmont County continued as the second ranking coal-producing county with an output of 5.4 million tons. Seventy-two percent of the production came from 13 underground mines; the remainder came from 19 strip and 5 auger mines. Six coal preparation plants processed 3.6 million tons of cleaned coal. In addition, 2 million tons of coal was crushed, and 252,000 tons was treated with calcium chloride or oil. Somerton Crushing Co., Somerton, and George & C. H. McCort, Malaga, quarried limestone.

Brown.—Limestone for aggregate, agstone, and other uses was produced by the Brown County Highway Department. Sand and gravel was produced by Government-and-contractor operations.

Butler.—The county ranked fourth in sand and gravel production. Output was 2.1 million tons valued at $2.4 million. Most producing companies operated stationary plants. One small producer sold pit-run material. The larger operators included Hamilton Gravel Co., Middletown Sand & Gravel Co., Morman Sand & Gravel Corp., American Materials Corp. (two plants), Ohio Gravel Co., and Ed & Joe's Gravel Pits. Government-and-contractor sand and gravel also was produced.

Carroll.—Coal production totaled 525,000 tons, 7 percent higher than in 1960. Nineteen mines (13 strip, 4 underground, and 2 auger) were active, compared with 16 mines in 1960. Clay (mostly plastic fire clay) was mined from four pits near Magnolia and one pit each near Mineral City and Waynesburg. Rainbow Stone Co. produced dimension and crushed sandstone from a quarry near Sherrodsville. Alan Stone Co., Inc., mined limestone at Carrollton for concrete aggregate. Mineral City Sand Co. produced molding and foundry sand.

Champaign.—Sand and gravel for highway use and as railroad ballast was produced by American Aggregates Corp., Urbana. Sand and gravel chiefly for use as fill was produced by Miller Excavating Service near Urbana. A small tonnage of material for highway use was produced by Water R. Dorsey at Springhill.

Clark.—Sand and gravel used chiefly for construction was produced by nine companies. A small tonnage of sand was sold for foundry use. The larger producers included Eagle City Sand & Gravel Co., Springfield Gravel Co., Keifer Sand & Gravel Co., Davon, Inc., and American Aggregates Corp. Output totaled 670,000 tons, an increase of about 200,000 tons over that of 1960. Moores Lime Co. produced limestone at Springfield for use as flux, aggregate, and agstone, and for manufacturing lime and deadburned dolomite. The company produced both quicklime and hydrated lime for construction, agriculture, and a variety of industrial uses.

Clermont.—Processed sand and gravel was produced at the Miamiville plant of Ohio Gravel Co. Fill gravel was produced by William Wehrmann & Son from a deposit east of Madeira. Limestone was produced at the Johnson Quarry near Felicity.

Clinton.—Limestone used mainly for aggregate, flux, and agstone was quarried near Melvin by Melvin Stone Co. The company also produced building sand and gravel at Wilmington. Clinton Gravel Co., Wilmington, produced paving and fill material.

Columbiana.—Coal production totaled 1.2 million tons, compared with 1.4 million tons in 1960. Forty-one mines (32 strip, 6 auger, and 3 underground) were active, compared with 51 mines in 1960. The county continued to rank second in the value of clays produced. Fire clay and miscellaneous clay were recovered from eight pits in the eastern part of the county. Sandy Beaver Stone Co. discontinued its sandstone-quarrying operation at Hanoverton. Sand and gravel was produced at operations near Hanoverton, Leetonia, and Salem. Most of the output was for building or highway use.

Coshocton.—Coal output increased 11 percent and totaled 2 million tons. Eighteen mines (10 strip, 7 underground, and 1 auger) were active, compared with 19 mines in 1960. Seven companies operated coal-crushing plants. Briar Hill Stone Co. operated seven sandstone quarries. The stone was sawed for architectural applications and for use as firestone in steel mills. Variegated Quarries Division, Nicholl Stone Co., also produced dimension sandstone. New Castle Lime Co. produced agricultural limestone and clay near Walhonding. Sand and gravel was produced at seven operations; output totaled 387,000 tons. Most of the material was processed for construction.

Crawford.—National Lime & Stone Co. produced limestone at its Spore quarry near Bucyrus. Output was crushed for aggregate, agstone, railroad ballast, and metallurgical uses. Crawford County Highway Department produced limestone for road building and maintenance. Galion Gravel Co. operated a stationary plant near Galion for the production of sand and gravel.

Cuyahoga.—Commercial and Government-and-contractor operations yielded 1 million tons of sand and gravel. Sales and average prices were about the same as in 1960; competition for contracts was strong. Ten commercial producers were active. Cuyahoga Lime Co. produced metallurgical quicklime at its newly constructed $1.5 million plant at Cleveland. Output was sold to nearby steel mills. The company used limestone shipped by boat from Michigan as its raw material. International Salt Co. began production of salt from its new underground salt mine at Cleveland. Miscellaneous clay and shale were produced at seven operations; output was used primarily for manufacturing building brick and lightweight aggregate. Crude perlite from Western States was expanded at the Cleveland plant of Cleveland Gypsum Co.

Darke.—Five sand and gravel companies reported production, compared with seven in 1960. However, output was 328,000 tons—an increase over the 1960 figure. Unit value, however, remained about the same. The largest producer was American Aggregate Corp., Greenville. Clay for manufacturing heavy clay products was produced by R. E. Clark, Versailles, and Darke County Tile Co., Greenville. Woodrow Gary, New Madison, mined calcareous marl for agstone. Humus peat was produced near Woodington by Louie Meyer.

Defiance.—Ohio Materials, Inc., Hicksville, and Northwest Materials, Inc., Defiance, produced sand and gravel chiefly for building construction and highway use. Total output was about half that of 1960, indicating less use on county and township roads.

Delaware.—Limestone used mainly for aggregate and agstone was produced by Marble Cliff Quarries Co., Powell; The Owens Stone Co., Ostrander; and Penry Stone Co., Radnor. National Lime & Stone Co. purchased and operated the Delaware limestone quarry of Scioto Lime & Stone Co. for production of aggregate, railroad ballast, and raw material for producing lime. Scioto Lime & Stone Co. continued operating its lime plant; quicklime and hydrated lime were produced mainly for use in water purification. The Galena Shale Tile & Brick Co. and Delaware Clay Co. mined shale near Galena and Westerville, respectively.

Erie.—Limestone used mainly as aggregate, railroad ballast, and agstone was produced by Castalia Quarries Co., Castalia; Sandusky Crushed Stone Co., Inc., Parkertown; and Wagner Quarries Co., Sandusky. Late in 1960, cement production was discontinued at the Bay Bridge plant of Medusa Portland Cement Co. However, the company made shipments of finished portland cement during the year and converted cement storage silos into a distributing facility. Keener Sand & Clay Co. and Ohio Foundry Sand Co. produced foundry sand. Output was about the same as in 1960.

Fairfield.—Sand and gravel production was reported by six companies. Use was chiefly for concrete construction and highways. Output was about the same as in 1960, totaling slightly less than 300,000 tons.

Fayette.—Blue Rock, Inc., Greenfield, and Fayette Limestone Co., Inc., and Sugar Creek Stone Quarry, Inc., both near Washington Court House, produced limestone used mainly for aggregate and agstone.

Franklin.—Sand and gravel production totaled 3.3 million tons, about 250,000 tons less than in 1960. Most of the output was for building construction and highway use. Thirteen operations, mainly near Columbus, were active. Marble Cliff Quarries Co., Columbus, mined limestone for a variety of uses and produced quicklime and hydrated lime at its nearby plant. Shale for manufacturing heavy clay products was produced near Blacklick by Columbus Clay Manufacturing Co. and The Claycraft Co. W. C. Utzinger & Sons produced reedsedge peat at Grove City.

Gallia.—Coal production totaled 727,800 tons, a 16-percent decrease from 1960. The number of active mines (12 underground, 7 strip, and 3 auger) decreased from 29 to 22. M. T. Epling Co. (Gallipolis) produced sand for building construction and highway use and some blast sand. Keener Sand & Clay Co., Kerrs, produced sand for foundry use. James Merry Stone Co. quarried and crushed limestone at its Flint Rock plant near Gallipolis. Jess Brammer mined shale near Waterloo for manufacturing floor and wall tile.

Geauga.—R. W. Sidley, Inc., produced construction and industrial sands (including ground) at Thompson. Construction sand and gravel also was produced at seven other operations. Harbison-Walker Refractories Co. mined quartzite for refractory brick at Thompson.

Greene.—In terms of value, Greene County continued as the leading cement-producing county. Portland and masonry cements were produced by Southwestern Portland Cement Co. and Universal Atlas Cement Division of United States Steel Corp., both near Fairborn.

Both companies mined limestone and clay as their principal raw materials. Universal Atlas also produced sand. Finished-cement shipments were principally to consumers in Ohio, Indiana, and Kentucky. Blue Rock, Inc., began developing a limestone quarry near Cedarville. Output of sand and gravel totaled 692,000 tons, a considerable decline from the 1960 production of 1.1 million tons. Nine producers were active, compared with 11 in 1960.

Guernsey.—Coal output was 22 percent less than in 1960 and totaled 190,000 tons. Eleven mines (6 strip, 4 underground, and 1 auger) were active. Three companies operated coal-crushing plants. John Gress & Sons, Inc. (formerly John Gress Co.), quarried limestone for concrete aggregate and roadstone at New Concord.

Hamilton.—Hamilton County continued as the leading sand- and gravel-producing county. Commercial production totaled 3.6 million tons, 5 percent less than in 1960. Output by Government-and-contractor operations totaled 308,000 tons, compared with 390,000 in 1960. Most of the production was centered near Cincinnati; 14 commercial producers were active. Ohio Gravel Co., with four plants, was the leading producer. Limestone was recovered as a byproduct of sand and gravel production at the Newton and Camp Dennison plants of Ohio Gravel Co. Crude perlite shipped from Colorado was expanded at the Cincinnati plant of Philip Carey Manufacturing Co. for use in insulation.

Hancock.—Pifer Stone Co., Hancock, and Tarbox-McCall Stone Co. and National Lime & Stone Co., both near Findlay, quarried limestone used mainly for concrete aggregate. Hancock Brick & Tile Co. mined clay near Findlay. Northern Ohio Sugar Co., a subsidiary of The Great Western Sugar Co., produced and used quicklime for sugar refining at Findlay. H. & M. Sand & Gravel Co. produced construction sand and gravel at Findlay.

Hardin.—The Hardin Quarry Co., Dunkirk, and Herzog Lime & Stone Co., Forest, produced limestone for a variety of uses.

Harrison.—Harrison County continued to lead the State's 25 coal-producing counties. Coal output increased slightly from the 1960 figure and totaled 7.4 million tons. Sixty-five percent of the output came from 12 strip mines; the remainder came from 6 underground and 4 auger mines. Most of the coal was cleaned at the Georgetown plant of Hanna Coal Co., Division of Consolidation Coal Co., and the Nelms plant of Youghiogheny & Ohio Coal Co. In addition, a substantial quantity of coal was crushed and treated for dust preventative and antifreezing. Hanna Coal Co. also quarried limestone for aggregate and agstone at Cadiz. Shale for manufacturing farm draintile was mined by Bowerston Shale Co., Bowerston.

Henry.—Turkey Foot Sand & Gravel and Napoleon Sand & Gravel Co., both near Napoleon, produced construction sand and gravel. August Honeck & Son, Malinta, and Napoleon Brick & Tile Works, Napoleon, mined clay. Trilobite and specimens of calcite and marcasite were reportedly recovered from the Pugh quarry.

Highland.—Highland Stone Division, Davon, Inc., Hillsboro; Ohio Asphaltic Limestone Co., Inc., New Vienna; and Marshall Quarry, Marshall, quarried limestone used mainly for aggregate. Mowrystown Brick & Tile Co., Mowrystown, mined miscellaneous clay for manufacturing draintile and building brick. Sand and gravel was produced by Greenfield Sand & Gravel Corp., Greenfield, and Hillsboro Gravel Co. and Uhrig & Collins, both near Hillsboro.

Hocking.—Coal output totaled 54,800 tons, 13 percent less than in 1960. Nine mines (4 strip, 3 underground, and 2 auger) were active, compared with 13 mines in 1960. Three companies operated crushing plants. General-Hocking Brick Co. mined plastic fire clay and miscellaneous clay from two pits near Logan and used it for manufacturing building brick. Selenite crystals were recovered near Logan by an amateur mineral collector. Donahey Bros., Logan, discontinued its sand and gravel business. Some sand and gravel was recovered by Government-and-contractor operations.

Holmes.—Production of coal increased from 83,000 tons in 1960 to 172,000 tons. Seven mines (five strip, one underground, and one auger) were active, compared with six mines in 1960. Four companies operated coal-crushing plants. Dimension sandstone was produced by Briar Hill Stone Co. at two localities and by Variegated Quarries Division, The Nicholl Stone Co., at Richland Township. Variegated Quarries also fabricated sandstone mined in Coshocton County. Output from both companies was used in architectural applications. Holmes Clay Division of Holmes Limestone Co. mined plastic fire clay and limestone at Berlin. Clay also was mined by General Clay Products Co. at Baltic, and Belden Brick Co. and Massillon Refractory Co., both near Berlin. Sand and gravel was recovered from pits near Millersburg.

Huron.—Huron Sand & Gravel, Inc., produced building and paving gravel at New London. Mel-lo Peat Co. recovered humus peat from bogs near Willard. Salisbury Pottery, Inc., discontinued mining operations; the corporation was dissolved in March.

Jackson.—Coal output from 10 strip and 5 underground mines totaled 298,000 tons, 5 percent less than the 1960 output. Waterloo Coal Co., Inc., cleaned coal by wet washing at its Waterloo plant. Six companies operated coal-crushing plants. Fire clay used chiefly for refractory purposes was recovered at three operations (four in 1960) near Oak Hill. Limestone for concrete aggregate was quarried at Oak Hill. The Jackson Works of Pennsylvania Glass Sand Corp. discontinued mining operations in late 1960.

Jefferson.—Coal production totaled 3.1 million tons, 8 percent less than in 1960. Jefferson County continued to rank third in coal production. Fifty-one mines (28 strip, 15 underground, and 8 auger) were active, compared with 50 mines in 1960. Sixty-five percent of the coal was strip-mined, 23 percent was mined underground, and 12 percent came from auger mines. Coal was cleaned at the Jensie plant of North American Coal Corp. and the Piney Fork plant of Hanna Coal Co., Division of Consolidation Coal Co. Seven companies operated coal-crushing plants. Fire clay and miscellaneous clay and shale were recovered from pits near Irondale, Toronto, Wellsville, and Empire. Output came from six operations and was used mainly for fire brick and block and for manufacturing vitrified sewer pipe. Sandstone used as rubble was quarried near Hammondsville by Freeport Quarries, Inc.

Knox.—Output of sand and gravel increased 4 percent and totaled 777,000 tons. Mostly construction sand and gravel was recovered by seven producers. Millwood Sand Co. produced industrial sands at Howard. Briar Hill Stone Co. operated two quarries for the production of dimension sandstone used for architectural applications.

Lake.—Morton Salt Co. produced rock salt at its Fairport underground mine near Painesville. Diamond Alkali Co. produced salt brine from wells and produced quicklime at its Painesville plant. The brine and quicklime were used for manufacturing chlorine and alkalies. Standard Portland Cement Division, Diamond Alkali Co., produced portland and masonry cements at Painesville, using clay mined nearby and purchased limestone and gypsum. Shipments of finished portland and masonry cements were made to consumers in Ohio and western Pennsylvania. D. H. Kenney Gravel Co., Painesville, quarried sandstone used as riprap. Output of sand and gravel decreased; production was reported from eight operations.

Lawrence.—Portland and masonry cements were produced by Marquette Cement Manufacturing Co., Superior, and Alpha Portland Cement Co., Ironton. Marquette mined limestone and shale and Alpha mined sandstone for use as cement raw materials. In addition, gypsum and iron materials were used by the companies as cement raw materials. Deliveries of finished portland cement were made to Ohio, West Virginia, Kentucky, and Virginia. Clay was recovered from operations near Ironton, Blackfork, and Pedro; output (mostly fire clay) was reported from nine operations. W. E. Engle Co. leased and operated the Pedro limestone quarry of O. K. Limestone Co. Output was used as aggregate and riprap. Lawrence County Highway Department quarried limestone for road construction and repair. Wilson Sand & Gravel Co. produced construction sand and gravel at Chesapeake. Lawrence Refractories Clay Co. produced refractory sand at Pedro. Coal production decreased from 449,000 tons in 1960 to 432,000 tons. Production came from four strip mines and one auger mine.

Licking.—Sand and gravel production increased and totaled 667,000 tons. Mostly construction material was recovered from the 14 active operations. Newark and Granville were the principal areas for production. Specimens of flint were recovered by mineral collectors near Flint Ridge.

Logan.—Crushed limestone, mainly for concrete aggregate, was produced by C. E. Duff & Sons, Inc., Huntsville, and Northwood Stone & Asphalt Co., Belle Center. Connolly Construction Co. acquired and operated the East Liberty limestone quarry of National Lime & Stone Co. Sand and gravel was recovered at five operations, two near Bellefontaine, and one each near Huntsville, Zanesfield, and Quincy. Thompson's Peat Moss Co. produced moss peat from bogs near West Liberty.

Lorain.—Cleveland Quarries Co., Amherst, and The Nicholl Stone Co., Kipton, produced dimension sandstone, used chiefly in architectural applications. Some stone was fabricated for use in lining steel furnaces. Nicholl Stone Co. also produced grindstones. Output of construction sand and gravel decreased and came from operations near

Amherst and Lorain. National Gypsum Co. calcined crude gypsum at Lorain.

Lucas.—Medusa Portland Cement Co. produced portland and masonry cements at Toledo, mainly from limestone, clay and shale, and sand mined nearby. Shipments of finished cement were made to consumers in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Limestone used mainly for concrete aggregate was produced by The France Stone Co., Waterville; Maumee Stone Co., Maumee; and Toledo Sand & Glass Sand Co., Sylvania. Dimension limestone was produced at the Whitehouse quarry of The Toledo House of Correction. Construction sand and gravel was produced near Toledo. Fossil and pyrite specimens were recovered by mineral collectors at various quarries.

Madison.—West Jefferson Sand & Gravel Co., West Jefferson, and McMullen Sand & Gravel Co., Mount Sterling, produced construction sand and gravel. Madison Stone Co., Inc., Galloway, and Connolly Construction Co., Plain City, produced limestone mainly for concrete aggregate. Clay was mined from a pit near London.

Mahoning.—Coal output totaled over 1 million tons, a 14-percent increase over the 1960 figure. Twenty strip mines were active, compared with 16 in 1960. Four companies operated coal-crushing plants. Beaver Peat Products Co., Damascus, and Stuckey's Peat Products, Beloit, produced peat. Carbon Limestone Co. produced limestone near Lowellville, mainly for open-hearth flux. Clay used for manufacturing brick was produced at pits near Alliance, Beloit, and Canfield. Lowellville Sand & Gravel Inc., Lowellville, and Gurlea Sand & Gravel, Salem, produced construction sand and gravel.

Marion.—Limestone used primarily for concrete aggregate and roadstone was produced by National Lime & Stone Co. and J. M. Hamilton & Sons Co., both near Marion, and Tri-County Stone Co., LaRue. Sand and gravel was produced by Prospect Sand Co., Prospect, and Penry Stone Co., Radnor. Marion Brick Corp. produced clays near Iberia. LaRue Tile Co., LaRue, was idle.

Medina.—Sand and gravel was produced at five operations, three near Lodi, and one each near Seville and Wadsworth. Production totaled 542,000 tons. Wadsworth Brick & Tile Co. mined clay at Wadsworth.

Meigs.—Construction sand and gravel was produced by Goeglein Gravel Co., Middleport, and Richards & Sons, Inc., and Tri-State Materials Corp., both near Apple Grove. Excelsior Salt Works, Inc., produced evaporated salt in open pans at Pomeroy. Coal production totaled 233,000 tons, and was 18 percent higher than in 1960. Seventeen mines (9 underground, 5 strip, and 3 auger) were active, compared with 12 mines for 1960.

Mercer.—The John W. Karch Stone Co., Celina, and Rockford Stone Co., Rockford, produced limestone mainly for concrete aggregate.

Miami.—Armco Steel Corp., Piqua, produced limestone, principally for metallurgical flux and concrete aggregate. Output of sand and gravel totaled 464,000 tons, 18 percent less than in 1960. Most of the output was processed material; seven operations were active. Skinner's Soil Conditioners produced humus peat from bogs near New Carlisle.

Monroe.—Paving sand and gravel was produced by Blaney Sand & Gravel Co., Inc., Clarington. Paving bank-run gravel was produced by Piatt Bros at the Witten gravel pit at Woodsfield. The Summerfield limestone quarry of Christman Quarry Co. was idle.

Montgomery.—The county continued to be an important producer of sand and gravel. Output by commercial producers totaled 2.9 million tons, virtually the same as in 1960. Output by Government-and-contractor operations totaled 336,000 tons; none was reported in 1960. Twenty-five commercial operations were active, mainly near Dayton. Carey Brothers Stone Co. and Limestone-Dayton Division of American Aggregates Corp., both near Dayton, produced limestone. The Phillipsburg quarry of Laura Gravel & Stone Co. was sold to American Aggregates Corp. in June. The City of Dayton Water Department recovered lime from waste sludge and from the recarbonation of water in its purification and softening process. Surplus lime was sold to other municipalities.

Morgan.—Coal production totaled 2.3 million tons, 56,000 tons more than in 1960. Three strip mines and one auger mine were active, compared with two strip mines and one underground mine in 1960. Central Ohio Coal Co. produced most of the output from its Muskingum mine and cleaned the coal at its Roberts and Schaefer preparation plant. Stockport Sand & Gravel Co. produced construction sand and gravel at Stockport. J. L. Prewitt recovered and processed limestone as concrete aggregate at the Reinersville pit of Central Ohio Coal Co.

Morrow.—Chesterville Sand & Gravel Co. produced construction sand and gravel at Chesterville.

Muskingum.—Columbia Cement Corp., East Fultonham, produced portland and masonry cements, chiefly from limestone recovered underground and shale from a nearby open pit. Cement was shipped primarily to consumers in Ohio and West Virginia. Sidwell Bros., Zanesville, and Chesterhill Stone Co., E. Fultonham, quarried limestone. Clay was recovered from pits near East Fultonham, Fraziersburg, Roseville, and Zanesville. Muskingum River Gravel Co., Zanesville; Zanesville Gravel Co., Dresden; and Donald E. Minnich, Trinay, produced sand and gravel. Coal production decreased from 591,000 tons in 1960 to 101,000 tons. Six underground and five strip mines were active, compared with eight underground, six strip, and three auger mines in 1960.

Noble.—Coal production decreased 22 percent and totaled 1.4 million tons. Eleven strip and three auger mines were active. James Merry Stone Co. and Lawrence King, both near Caldwell, and Herman Zerger, Jr., Stock Township, quarried limestone, mainly for concrete aggregate. Ava Brick Corp. produced shale for manufacturing face brick near Ava.

Ottawa.—United States Gypsum Co., Genoa, quarried limestone for producing lime at its nearby plant and for sale as concrete aggregate and roadstone. Mostly hydrated lime was produced for sale as finishing and mason's lime. The Clay Center lime plant of Basic, Inc., was idle; however, the company continued operating its nearby limestone quarry. Limestone also was produced by Chemstone Corp., Division of Minerals & Chemicals Philipp Corp. at Marblehead. Output was sold as aggregate, agstone, flux, and sinter stone. Celotex Corp., Port

Clinton, and United States Gypsum Co., Gypsum, mined crude gypsum for calcining at nearby plants. The calcined gypsum was used for manufacturing finished gypsum building products. Specimens of celestite were recovered near Clay Center by mineral collectors.

Paulding.—Portland and masonry cements were produced by Peninsular Portland Cement Division, General Portland Cement Co., Paulding, from limestone and shale mined nearby. Deliveries of finished cement were made to consumers in Ohio, Indiana, and Michigan. Some of the limestone mined at the Peninsular quarry was shipped to the company plant in Michigan, and some was sold to The France Co., Paulding, for processing and sale for concrete aggregate, roadstone, railroad ballast, and agstone. Limestone also was produced by Auglaize Stone Co., Oakwood, and Junction Quarry, Inc., Junction. Clay was produced by Baughman Tile Co., Broughton, Dangler Drain Tile Co., Paulding, and Haviland Clay Works Co., Haviland.

Perry.—Coal production totaled 1.7 million tons, 6 percent above the 1960 output. Most of the production came from nine strip mines; seven underground and two auger mines also were active. Peabody Coal Co. cleaned coal with jigs at its Sunnyhill No. 9 preparation plant. Sidwell Bros. Coal Co. cleaned coal at its McNally-Norton preparation plant. Industrial sands were produced by Central Silica Co., Glenford, and Keener Sand & Clay Co., New Lexington. Clays, mostly miscellaneous clay and shale, were recovered from pits near Gore, Junction City, Logan, New Lexington, Saltillo, Somerset, and Shawnee. Nine operations were active, compared with 10 in 1960. The lightweight aggregate (expanded shale) plant of Buildex, Inc., at New Lexington was closed at the end of 1960. The company reported insufficient demand for lightweight aggregate in the area. Limestone was quarried and crushed by Beiter Stone Co., Rushville, and Maxville Stone Co., Logan.

Pickaway.—Sturm & Dillard Co. produced processed sand and gravel at Circleville. McFarland Co., Circleville, produced bank-run gravel.

Pike.—Industrial sand and gravel was produced at Beaver and Jackson; construction sand and gravel at Sargents, Lucasville, and Waverly. Ralph Rogers & Co. of Ohio, Inc., produced limestone for aggregate and agstone at Latham.

Portage.—Output of sand and gravel decreased from 2.1 million tons in 1960 to 1.8 million tons. Twenty-four operations (one less than in 1960) were active; production was centered mainly near Ravenna, Kent, and Mantua. Industrial Silica Division, Pennsylvania Glass Sand Corp., produced industrial sands at the Geauga Works near Aurora and the Portage Works near Garrettsville. Harbison-Walker Refractories Co. and General Refractories Co. mined quartzite for silica brick. The quartzite quarry of Kaiser Refractories and Chemicals Division, Kaiser Aluminum & Chemical Corp., did not operate. United States Concrete Pipe Co. mined shale near Diamond. The Deerfield limestone quarry of City Asphaltic & Paving Co. was idle. Peterson Coal Co. operated its Atwater strip mine and was the only coal operator active during the year. Peat was recovered from bogs near Ravenna by Green Oaks Peat Moss Co. and Portage Peat.

Preble.—Marble Cliff Quarries Co. mined limestone to supply its Lewisburg lime plant and for sale as agstone, concrete aggregate, and blast-furnace flux. Construction sand and gravel was produced by White Gravel Co., Camden, and Steiner's Sand & Gravel Co., and Blue Bank Gravel Co., both near West Alexander.

Putnam.—National Lime & Stone Co., Columbus Grove and Ottawa Stone Co. and The Putnam Stone Co., both near Ottawa, mined limestone. Etter Tile & Coal Co., Dupont; Glandorf Tile Co., Glandorf; Miller Bros. Clay Works, Inc., Ottoville; and Leipsic Clay Products Co., Leipsic, mined clay for manufacturing draintile.

Richland.—Sand and gravel production increased and totaled 442,000 tons. Producers were H. W. Fleck & Son, Inc., Lexington; Mohican Sand & Gravel Co., Killbuck; and D. H. Bowman & Sons, Inc., and Derwacter Sand & Gravel, both near Belleville. Ohio Brick & Supply Co. and Richland Shale Brick Co., both near Mansfield, mined shale. Moss peat was recovered from bogs near Ganges by Reynolds Farms, Inc.

Ross.—Chillicothe Division, The Mead Corp., produced quicklime used for manufacturing paper at its Chillicothe plant. Construction sand and gravel was produced at two plants near Chillicothe and one each near Bainbridge and Richmondale. Sandstone for foundry use, glass manufacture, and ganister was quarried at Richmondale by Southern Silica, Inc. Paint Valley Sand & Gravel Co., Bainbridge, quarried limestone.

Sandusky.—The county continued to lead in production of lime and limestone. Output of lime (including deadburned dolomite) decreased 1 percent and totaled 892 million tons value at $14.5 million. Nine lime plants were active. Most of the output was deadburned dolomite used as refractory material by the steel industry. Limestone was produced at nine quarries, three each near Gibsonburg and Woodville, and one each near Bellevue, Fremont, and Millersville. Limestone output totaled 3.2 million tons, slightly higher than in 1960. Fifty-eight percent of the limestone was used for manufacturing lime, 16 percent for concrete aggregate and roadstone, 15 percent for metallurgical flux, and the remainder for all other uses including agstone. Mineral specimens consisting of celestite and aragonite were recovered near Woodville. The Home Sand & Coal Co., Fremont, produced building sand by dredging.

Scioto.—Waller Bros. Stone Co. and The Taylor Stone Co., both of McDermott, quarried and sawed sandstone for furnace brick and architectural purposes. Quartzite for silica brick was produced at the Denver quarry near Portsmouth by General Refractories Co. Clay (mostly fire clay) was recovered from pits near Portsmouth and South Webster. Bank-run sand and gravel was produced near Lucasville by Lucasville Sand & Gravel.

Seneca.—Basic, Inc., produced deadburned dolomite at its Maple Grove plant from dolomite mined nearby. Dolomite also was sold for aggregate, roadstone, agstone, and metallurgical uses. Limestone was quarried by The France Stone Co. and Webster Stone Co., Bloomville, and Northern Ohio Stone Co., Flat Rock. St. Stephen Tile

Co., St. Stephen, and J. A. Miller Tile Co., Bascom, produced clay for manufacturing draintile.

Shelby.—The Sidney Sand & Gravel Co., Sidney; Spring Creek Gravel Co., Fort Laramie, and The Ernst Gravel Co., Houston, produced construction sand and gravel. Miami River Quarries, Inc., produced limestone for aggregate, riprap, and rubble.

Stark.—Diamond Portland Cement Co., Division of The Flintkote Co., produced portland and masonry cements at its Middle Branch plant, from limestone and shale mined nearby. Shipments of finished portland cement went to consumers in Ohio, Pennsylvania, and West Virginia. Limestone used primarily for construction was produced by Alborn Coal & Lime Co., East Sparta; Alliance Stone, Inc., Alliance; East Ohio Limestone Co., Hartville; and Elmco Limestone & Coal Co., Canton. Clay (73 percent fire clay) was recovered from 19 operations and used chiefly for refractories and heavy clay products.

Coal production increased from 695,000 tons in 1960 to 764,000 tons. Fifteen strip mines were active, compared with 17 strip mines and 1 auger mine in 1960. Sand and gravel production totaled 1.7 million tons, compared with 1.3 million tons in 1960. Production was reported from operations mainly near Canton, Massillon, and Navarre. Seventeen operations were active, compared with 19 in 1960. Peat was produced by Gerald R. Hetrick, Lab Nursery & Peat Moss, Lantz Peat Moss, Inc., and Sanders Peat Moss Co., all near Canton. Fossils used as mineral specimens were recovered near Hartville.

Summit.—Pittsburgh Plate Glass Co., Chemical Division, Barberton, formerly Columbia-Southern Chemical Corp., produced evaporated salt from brine pumped from nearby wells. The company also produced lime which was used with some of the brine for manufacturing soda ash and chlorine. Raw material for the lime plant as well as for the company cement plant was supplied from its underground limestone mine. Finished portland cement was shipped to consumers in Ohio, Pennsylvania, and West Virginia. Diamond Crystal Salt Co. produced evaporated salt and brine from wells at Akron. Evaporated salt was produced in both open and vacuum pans; some was marketed as pressed blocks. Pittsburgh Plate Glass Co. quarried sandstone at Norton for manufacturing glass and for use as concrete aggregate. Production of sand and gravel decreased, output came mainly from operations near Akron and Barberton; 15 operations were active. Mineral specimens (fossils) were recovered near Barberton by an amateur collector. No peat was produced in 1961. J. T. Loomis Concrete Supply Co., Akron, discontinued the production of expanded perlite at the end of 1960. Camp Brick Co. produced shale at Mogadore; Robinson Clay Products Co., Mogadore, mined plastic fire clay and miscellaneous clay.

Trumbull.—Kinsman Sand & Gravel Co., Kinsman, produced building and paving sand and gravel.

Tuscarawas.—Coal production totaled 2.3 million tons, 7 percent less than in 1960. Output came from 48 mines (29 strip, 13 underground, and 6 auger), compared with 53 mines in 1960. Coal was cleaned by diaphragm jigs and air tables at the Midvale mine of Pittsburgh Plate Glass Co. The county continued to rank first in production and value of clay. Output (76 percent fire clay) was reported from 28 active mines (26 in 1960). Most of the fire clay was used for refractories and heavy clay products; miscellaneous clay was used chiefly for manufacturing heavy clay products. Sand and gravel was produced at eight operations. Industrial Silica Division, Pennsylvania Glass Sand Corp., produced industrial sands at the Coxey Works near Dundee. Bonum Lime Co., Sugar Creek; Kimball Limestone Co., Dover; and Limestone Aggregates, Inc., Strasburg, quarried limestone. Dimension sandstone for architectural uses was quarried at Dundee by Yoder Stone Co.

Union.—Limestone used chiefly for construction and agstone was quarried by L. G. Rockhold & Sons, York Center, and Union Limestone, Inc., Ostrander. Construction sand and gravel was produced by Marysville Concrete & Materials, Inc., Marysville.

Van Wert.—Union Quarries Co., Scott; Ridge Township Stone Quarry, Van Wert; and Delphos Quarries Co., Delphos, quarried limestone, principally for concrete aggregate. Weck Tile Plant mined clay at Van Wert for manufacturing draintile.

Vinton.—Coal production decreased from 235,400 tons in 1960 to 149,500 tons. Twelve mines (7 underground and 5 strip) were active, compared with 14 mines in 1960. The McArthur Brick Co. mined plastic fire clay and shale for building brick near McArthur. Limestone for aggregate and agstone was quarried at McArthur by McArthur Stone & Coal Co.

Warren.—Production of commercial sand and gravel decreased and totaled 564,000 tons. Material was recovered from operations near Franklin, Morrow, Lebanon, Loveland, South Lebanon, and Waynesville. Eight operations were active.

Washington.—Coal production totaled 235,000 tons, 10 percent less than in 1960. Three strip and two auger mines were active. Yonker Coal, Inc., operated a crushing plant. Construction sand and gravel was produced at Little Hocking, Marietta, New Matamoras, and Waterford. Abrasive stone (grindstone) was produced at Constitution by Hall Grindstone Co.

Wayne.—Evaporated salt was produced in vacuum and open pans by Morton Salt Co. at Rittman. Some was marketed as pressed blocks. Mullet Coal Co. produced crushed limestone and plastic fire clay at Mount Eaton. Limestone for aggregate was produced by Wayne County Quarries, Inc., at Fredericksburg. Sand and gravel was produced at six locations. Medal Brick & Tile Co., Wooster, and Orrville Tile Co., Orrville, mined clay. Coal production increased 42 percent from 1960. Two strip mines were active. Wayne County Quarries, Inc., operated a crushing plant.

Williams.—Tri-State Gravel Co., Pioneer; Mason Sand & Gravel Co., Edon; Wortkoetter Gravel Co., Blakeslee; and Hoffman Sand & Gravel, Edgerton, produced sand and gravel. Clay for draintile was produced by Stryker Drain Tile Co., Stryker.

Wood.—Limestone was produced at seven quarries. Producers were The France Stone Co., Luckey and North Baltimore; Maumee Stone Co., North Baltimore and Lime City; Wood County Stone & Construction Co., Bowling Green; Pugh Quarry Co., Custar; and The

Brough Stone Co., West Millgrove. Output was used primarily as aggregate, agstone, and flux. Clays were produced by Roosford Brick & Tile Co. and Perrysburg Brick & Tile Co., both near Perrysburg. Specimens of celestite were recovered by mineral collectors.

Wyandot.—The National Lime & Stone Co. quarried limestone and produced lime at Carey. In addition to supplying the lime plant, limestone was marketed for aggregate, metallurgical flux, railroad ballast, agstone, glass manufacturing, and fertilizer filler, and for controlling dust in coal mines. The company produced mainly quicklime used by the glass industry. Quicklime and hydrated lime were shipped to 19 States; some was exported to Canada. J. L. Foucht Quarry produced limestone at Upper Sandusky. Wilson Sand Co. and Corfman Gravel Co., both near Upper Sandusky, produced sand and gravel. The Claycraft Co., Upper Sandusky, mined shale for manufacturing building brick. In terms of value Wyandot County was the leading peat-producing county. The Humus Co. mined peat at Carey for sale in packages and bulk.

The Mineral Industry of Oklahoma

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior and the Oklahoma Geological Survey.

By Robert B. McDougal[1] and William E. Ham[2]

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FIVE MINERAL fuels and 12 minerals, produced in 75 of Oklahoma's 77 counties in 1961, were valued at $786 million, $5 million more than in 1960 although some $23 million below the high in 1957.

The gain over 1960 was due largely to increased output and sales of cement and natural gas. However, the coal industry, already under competitive pressure from other mineral fuels, felt the effect of a reduced transportation rate for coal shipped from Kentucky, Virginia, and West Virginia to steel centers in California and Utah. An approximate reduction of 26 percent in railroad rates was effective August 7, 1961.[3]

Oklahoma was the third largest producer of natural gas and natural gas liquids and ranked fourth in crude petroleum output. Substantial quantities of cement, coal, gypsum, sand and gravel, and stone also were produced. Federal legislation for subsidy payments provided impetus for increased output of lead and zinc.

The value of mineral fuels—petroleum, natural gas, natural gas liquids, coal, and helium—comprised more than 94 percent of the total value of minerals produced. The value of nonmetals and metals constituted the remainder. Natural gas and petroleum were produced from about 2,300 pools in 70 of the 77 counties; the pools were distributed principally in a wide belt which extended from the northeastern to the southwestern and western areas of the State. Helium was recovered in Cimarron County. Nonmetals were produced in a broad area encompassing 64 counties, primarily in the northeast, northcentral, and central areas, and in the Arbuckle and Wichita Mountain regions of the southern area.

Employment and Injuries.—*Employment and Wages.*—Oklahoma's mineral industries employed 45,000 persons in 1961; employment was slightly lower than in 1960. As defined by the Oklahoma Employment Security Act, which covers establishments that employ four or more persons, the mineral industries paid $264.8 million in wages to 43,300 persons.

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[3] Norfolk and Western Railroad Company Tariff C & C A-3-C, I.C.C. 3367-B (provisions establishing rate on coal from West Virginia origins to Geneva, Utah of $12.60 per ton). Supp. 46.

The Chesapeake and Ohio Railway Company Tariff 3036-A, I.C.C. 13755 (provisions establishing rate of $12.60 on coal from West Virginia origins to Geneva, Utah, effective August 7, 1961).

TABLE 1.—Mineral production in Oklahoma[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] ....thousand short tons..	734	$739	792	$801
Coal........do....	1,342	9,113	1,032	6,784
Helium........thousand cubic feet..	289,068	4,691	313,244	5,872
Lead (recoverable content of ores, etc.)......short tons..	936	219	980	202
Natural gas........million cubic feet..	824,266	98,088	892,697	108,016
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons..	531,995	33,074	521,237	33,358
LP gases........do....	762,258	32,409	817,082	30,141
Petroleum (crude)........thousand 42-gallon barrels..	192,913	563,306	[3] 191,834	[3] 558,237
Salt (common)........thousand short tons..	3	16	3	19
Sand and gravel........do..	6,424	7,468	5,310	5,513
Stone........do....	[4] 14,054	[4] 16,098	14,981	16,561
Zinc (recoverable content of ores, etc.)......short tons..	2,332	602	3,148	724
Value of items that cannot be disclosed: Asphalt (native) (1960), bentonite, cement, gem stones, gypsum, lime, pumice, stone (crushed granite) (1960) and tripoli....	....	16,757	....	21,920
Total Oklahoma [5]........	....	[6] 780,942	....	785,973

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producer).
[2] Excludes bentonite; included with "Value of items that cannot be disclosed."
[3] Preliminary figure.
[4] Excludes crushed granite; included with "Value of items that cannot be disclosed."
[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.
[6] Revised figure.

TABLE 2.—Annual average employment in the mineral industries

(Thousands)

Industry	1952-56 (average)	1957	1958	1959	1960 [1]	1961 [2]
Oil and gas drilling and production......	46.30	48.8	45.8	45.0	42.6	42.5
Coal mining........	1.34	1.1	.9	.9	.7	.6
Other mining........	2.34	1.9	1.8	1.8	1.8	1.9
Total........	49.98	51.8	48.5	47.7	45.1	45.0

[1] Revised figures.
[2] Preliminary figures.

Source: Oklahoma Employment Security Commission, Handbook of Oklahoma Employment Statistics, 1939-61.

Injuries and Fatalities.—In October, one miner was killed and one seriously injured when they were struck by a falling ore slab in a mine near Picher. Six men were burned, two seriously, in a fire and explosion on October 31 in two petrochemical units of a Tulsa refinery.

Consumption and Markets.—A significant part of the Oklahoma mineral output was processed into semifinished and finished products for intrastate use and interstate shipment. The industries included oil refineries; gasoline and cycle plants, which stripped condensable liquids from natural gas; a helium extraction plant; zinc smelters, which reduced zinc ore concentrate which was partly from Oklahoma; brick, tile, pottery, glass, and cement plants, which used clays, shales, silica sands, and limestone mined in Oklahoma; producers of building materials manufactured from gypsum mined in Oklahoma; and one producer of calcium carbide made from Oklahoma limestone. Pipelines transported large quantities of natural gasoline and petroleum products to industrial areas of the Eastern and North Central States. Ammonia was produced from natural gas, carbon black from petroleum distillates, and high-energy fuel from petroleum hydrocarbons reacted with boric acid and sodium.

Demand for Oklahoma crude petroleum again decreased; the total at yearend was nearly 3.3 million barrels less than in 1960. Under State regulatory control, output was maintained in close balance with demand and stocks.

Mining activity began to rise when American Zinc, Lead & Smelting Co. and The Eagle-Picher Co. reopened their custom mills in March to receive lead and zinc ores from local producers in the Tri-State District. In October, Federal legislation was enacted to provide subsidy payments to operators whose annual production was not more than 3,000 tons of lead and zinc combined. The producer would receive 75 percent of the difference between 14.5 cents per pound and the market price of zinc. Funds for the program, to be administered by the Office of Minerals Exploration (OME) of the Department of the Interior, had not been appropriated by yearend.

Total construction (residential, nonresidential, and public works) established a record in 1961; the value reached $1.1 billion, a 26-percent increase over 1960. An important factor was steady growth throughout the first three quarters. Residential construction was most important, as it was 31 percent greater than in 1960. Public works construction was 22 percent higher than in 1960. Factory construction which dropped 14 percent from 1960, was the second lowest recorded since 1954.

Trends and Developments.—Recoverable petroleum reserves continued to decline; however, natural gas reserves increased slightly. Exploratory well drilling was not particularly successful, as only 148 of 529 wells proved productive. Kingfisher County remained the leading county with 20 discoveries; Garfield County followed with 10; Beaver and Major Counties had 9 each; and Blaine and Texas Counties had 7 each. Since December 1958, only 6 dry holes had resulted from about 450 attempts in Kingfisher County. Hennessey field, center of most development drilling during the year, was extended northward into Garfield County and gave promise of an active future for the southern part of the county. The likelihood of a large gas reserve in the Arkoma Basin in southeastern Oklahoma and western Arkansas became more probable. Shallow producers, deepened to more than 10,000 feet, reached new pay zones in some oilfields.

A hydrodealkylation unit, capable of producing 1,000 barrels of benzene per day, was placed on stream about midyear by D-X Sunray Oil Co. at its Tulsa refinery. Charge stock for this second petrochemical unit is toluene produced in the adjoining petrochemical unit constructed in 1960. In September, the company placed an 85,000-barrel-per-day, three-stage crude oil distillation unit on stream at its Tulsa refinery. The new unit replaced five old crude oil units with a combined capacity of 75,000 barrels per day.

About yearend, Champlin Oil & Refining Co. completed a delayed-coking unit at its Enid refinery. The unit allowed further refinement of crude oil to produce 100 tons of coke per day, an additional 1,000 barrels of gasoline, and 300 barrels of burning oil per day.

At its Cushing refinery, Kerr-McGee Oil Industries, Inc., ceased manufacture of gasoline and fuel oils and produced only high-quality lubricating oils. Economic factors were cited for the cutback.

Bell Oil & Gas Co. completed remodeling of the Ben Franklin Refinery Co. refinery at Ardmore. Crude oil, formerly handled at Bell's Grandfield plant, was processed at Ardmore; Grandfield was converted into a terminal for asphalt and other products.

Continental Oil Co. placed on stream a new absorption and refrigeration-type natural gasoline plant near Medford. The $930,000 facility, capable of processing about 30 million cubic feet of gas per day, would recover propane, butane, and natural gasoline. Near Hennessey, the firm completed its $1.75-million natural gasoline plant; it was capable of recovering propane, butane, and natural gasoline from 30 million cubic feet of natural gas per day.

Humble Oil & Refining Co. announced plans to construct a $7.5 million natural gasoline processing facility in the Dover-Hennessey gas area south of Hennessey. Ultimate daily capacity was 77 million cubic feet of gas. To be operated by Humble for a group of producer-owners, the system was to include 2 booster stations and an 85-mile pipeline complex connected to about 275 wells. Limited operations began about yearend; all facilities were to be completed by mid-1962.

Continental Pipe Line Co. completed, about midsummer, a 62-mile gathering system from Kingfisher to Ponca City.

Mid-Continent Pipe Line Co. replaced a 6-inch line in its Velma to Duncan system with 5 miles of 10-inch pipe.

Phillips Pipe Line Co. completed a crude oil pipeline that connected wells in parts of 13 fields in the Oklahoma-Texas Panhandle to the company refinery at Borger, Tex. In Beaver and Texas Counties, connections were made in the Camrick, East Camrick, Northeast Camrick, Southeast Camrick, and Guymon-Hugoton Fields.

Sinclair Pipe Line Co. completed a 170-mile, 8-inch Oklahoma Panhandle line extending from Laverne to Newalla to provide more markets for oil producers in the North Anadarko Basin. Combined with the former Wheat Belt Pipeline Co., which Sinclair acquired earlier in the year, the new line provided crude-condensate and gas-plant-products outlets to refineries in the Houston and Chicago-Wood River areas.

Lone Star Gas Co. constructed a 14.5-mile pipeline from a point 15 miles west of Ardmore northeastward to the Pure Oil Co. gasoline plant in the Caddo Field. The 8-inch line extended an existing 6-inch line, which transported the gas to Dallas, Tex. Additional gas entering the Lone Star system was about 10 million cubic feet per day.

Oklahoma Illinois Gas Pipeline Co. announced plans to build a 600-mile pipeline from western Oklahoma through southeastern Kansas to the St. Louis, Mo., area.

Late in the year, Mid-Continent Pipe Line Co. began constructing a pipeline to extend its 4-inch crude oil gathering system from the Bald Hill station to serve the reactivated Muskogee Field. About 25 miles of main line and 12 miles of lease feeder lines marked the first pipeline entry into the Muskogee area since the last operating refinery closed in the early 1940's.

Cherokee Pipe Line Co. announced plans to construct a 127-mile petroleum-products line from Oklahoma City to Wichita Falls, Tex. At Oklahoma City, the line was to connect with the Cherokee Pipe Line Co. lateral line to Ponca City. The line also would connect at Wichita Falls with the Continental Oil Co. products line to Grapevine, near Dallas, Tex. Planned initial capacity to Wichita Falls was 20,000 barrels per day. A unique feature of the pipeline from Temple, Okla., to Wichita Falls was that part of the pipe to be used in the line would be manufactured from steel coils by a mobile mill which automatically welds pipe sections and lays them along the right-of-way.

Construction continued throughout the year on Continental Oil Co.'s new $2.2-million expansion program at its Ponca City research and development center.

In June, Dewey Portland Cement Co., division of American-Marietta Corp., placed on stream its new $12 million, 1.25-million-barrel plant northeast of Tulsa. The first clinker was produced on March 6. Except for the packing and shipping department, automatic control was maintained over all principal equipment and processes from consoles located in one central control room. The company plant at Dewey was shut down for an indefinite period in October, and at yearend it was still closed.

After operating 1 year, Oklahoma Cement Co. announced plans to increase plant capacity by 1 million barrels a year, at a cost of $5 million.

Public Service Co. of Oklahoma, about mid-October, dedicated its new *Northeastern* 170,000-kilowatt electric generating station. The power station was near the Oologah Dam, currently under construction by the U.S. Army Corps of Engineers, Tulsa District. Natural gas to fuel the station was delivered through a 24-inch-diameter Transok Co. line, an extension of the line supplying the Public Service Co. Tulsa power station on the Arkansas River. Scrubbed and metered in a regulator station, 44 million cubic feet of natural gas per day was fed into the furnace by 15 burners.

Two other dams in eastern Oklahoma—Eufaula on the South Canadian River between Haskell and McIntosh Counties and Keystone on the Arkansas River in Tulsa County—were also being constructed by the Corps of Engineers.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Oklahoma remained an important producer of natural gas and crude petroleum and furnished a major supply of refined petroleum products. Low-ash bituminous coal also was produced in substantial quantity; however, considerably less was produced than in 1960.

Coal (Bituminous).—Output decreased for the 4th consecutive year, as markets for Oklahoma coal declined further owing to increased coal shipments from Kentucky, Virginia, and West Virginia to California and Utah. Twenty-five operators at 27 mines in 10 counties mined 1 million tons valued at $6.8 million—23 percent less in tonnage and 26 percent less in value than the 1960 production. Haskell, Rogers, and LeFlore Counties led in value of output.

TABLE 3.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952-56 (average)	2,089	$12,438	1959	1,525	$10,272
1957	2,195	14,165	1960	1,342	9,113
1958	1,629	10,858	1961	1,032	6,784

Lone Star Steel Co. announced plans to reopen its Carbon No. 5 mine near Hartshorne; new mining equipment was installed at the mine for a more efficient operation. Sun River Mining Co., west of Howe, was sold about midyear. During the first half of the year, Sinclair Coal Co. transferred its coal mining operations from Sequoyah to a strip mine 2½ miles south of Chelsea, estimated to contain a 30-year supply. Sallisaw Stripping Co. moved its dragline, said to be the largest in the State, by barge about 7 miles up the Arkansas River near Sallisaw.

The Grand River Dam Authority (GRDA) discontinued an experiment in use of coal as a substitute for natural gas at its steam generating plant near Pryor, because of the higher cost of using both fuels.

Helium.—The Keyes helium plant operated by the Federal Bureau of Mines extracted 315 million cubic feet of helium from natural gas, a 7-percent increase over 1960. Sales to Government and other consumers totaled 313 million cubic feet valued at $5.9 million. Effective November 18, wholesale helium prices were increased from $19 to $35 per thousand cubic feet by the Bureau of Mines, in a move to carry out the Congressional mandate expressed in the Helium Act of 1960. Retail prices, which were not set by the Government, ranged from $60 to more than $110, depending on the quantity of helium involved and distribution and transportation costs.

Natural Gas.—Oklahoma ranked third in marketed output of natural gas. Texas, Garvin, Beaver, Harper, and McClain Counties led, in the order named, as 65 counties reported production. Late in the year, Roger Mills County became the 66th county in which gas had been found. The area is underlain by southdipping rocks on the north limb of the Anadarko syncline. Discovery of gas in Roger Mills County is in the deep, but not the deepest, part of the Anadarko Basin. The test well discovery was first drilled to 12,384 feet by Carter Oil Co. and abandoned in 1953. Gulf Oil Corp. reentered and deepened the hole to 17,558 feet. Perforations were made between 17,127 and 17,435 feet in Lower Morrow sandstones, and, had the flow not died, it would have established a new State producing depth record when gas flowed at a rate of 2.25 million cubic feet per day through a ½-inch choke. The hole was plugged back to 15,148 feet, and perforations were made between 14,960 and 14,980 feet in an Upper Morrow sandstone; the hole was treated to flow 4 million cubic feet per day through the ½-inch choke. In a quest for more reserves, the gas industry completed 514 gas wells of 5,845 wells of all types—gas, oil, condensate, service, and dry. The number of gas discoveries declined to 52 from 65 in 1960, as efforts were concentrated more on field wells than on test wells. In 1961, 462 gas wells were completed, compared with 369 in 1960. The Anadarko Basin, particularly Kingfisher County, remained the Nation's most active drilling area.

Six gas-storage fields were in use by the natural gas industry in six Oklahoma counties, and a seventh field was under construction in portions of two adjacent counties. Underground storage facilities had a total capacity of 104.1 billion cubic feet of working-gas volume (above minimum working pressure). Completion of Oklahoma Natural Gas Co.'s West Edmond underground facilities in Kingfisher and Logan Counties in November 1962 was expected to add 58 billion cubic feet to capacity. Temporary facilities in the West Edmond field were in use. The available storage capacity permitted continuous production and conservation of casinghead gas from oil wells in periods of low gas demand.

Natural Gas Liquids.—Recovery of natural gas liquids by 67 natural gasoline plants and 5 cycling plants totaled about 1.3 billion gallons, a 3-percent increase over 1960. Increased production of LP gases (propane and butane) accounted for the gain. Natural gasoline and cycle products supplied 39 percent of the quantity and 53 percent of

TABLE 4.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)	Year	Million cubic feet	Value (thousands)
1952-56 (average)	612,784	$42,851	1959	811,508	$81,151
1957	719,794	59,743	1960	824,266	98,088
1958	696,504	70,347	1961	892,697	108,016

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

TABLE 5.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1960	Changes in proved reserves, due to extensions and new discoveries in 1961	Proved reserves, Dec. 31, 1961 (production was deducted)	Changes from 1960, percent
Crude oil .... thousand barrels	1,790,500	184,774	1,787,429	----------
Natural gas liquids [1] .... do	338,313	17,716	329,180	−3
Natural gas .... million cubic feet	17,311,402	1,059,103	17,350,924	----------

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude oil, Natural Gas Liquids, and Natural Gas. V. 16, Dec. 31, 1961, pp. 11 12, 21.

the value; the remainder was furnished by LP gases. Use of LP gas as domestic heating fuels and for production of petrochemicals—particularly polyethylene—continued to rise.

In Love County, California Oil Co. placed on stream a new natural gas cycling plant in the Southeast Marietta field. The refrigeration-type plant had capacity to process 50 million cubic feet of gas a day into debutanized natural gasoline.

Underground storage capacity for LP gases at five sites totaled 633,000 barrels. The sites comprised two salt layers in Beaver and Beckham Counties, an abandoned oil well in Pontotoc County, a shale mine shaft in Seminole, and a newly completed reservoir mined out in limestone in Kay County. Additional storage facilities under construction at yearend were Gulf Oil Corp.'s 50,000-barrel project in a salt formation at the Warren Petroleum Co. gas processing plant near Mocane in Beaver County, and the Continental Oil Co. 150,000-barrel butane storage in a salt formation in Grant County.

TABLE 6.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	462, 523	$27, 434	467. 059	$16, 041	929, 582	$43, 475
1957	460, 644	25, 329	587, 140	21, 824	1, 047, 784	47, 153
1958	440, 798	26, 029	657, 114	25, 822	1, 097, 912	51, 851
1959	448, 353	29, 443	675, 869	27, 070	1, 124, 222	56, 513
1960	531, 995	33, 074	762, 258	32, 409	1, 294, 253	65, 483
1961	521, 237	33, 358	817, 082	30, 141	1, 338, 319	63, 499

Petroleum.—Oklahoma was again the fourth largest petroleum-producing State. Crude oil production was prorated by the Oklahoma Corporation Commission under the Interstate Oil Compact. The March allowable was set at 19 barrels per well daily—highest in 13 months—for a total daily output of 535,000 barrels. The daily rate was reduced for April, May, and June to maintain a balance between output and demand and to reduce the rising crude oil inventory. Shutdowns at four of six Sinclair Oil Corp. refineries in other States during part of June and most of July were partly responsible for retention of the 13-barrel-per-day rate in July. The 13-barrel rate was retained by the Commission until December, when a new formula went into effect. The depth-acreage formula, adopted earlier in the year, permitted higher allowable rates from deeper, wider-spaced wells and was also subject to a monthly "market demand" factor limiting all wells to a percentage of the basic allowable. The December rate was set at 40 percent of the market demand, which would yield about 525,000 barrels daily—up from the November allowable.

Petroleum from 80,814 wells was reported from 67 counties; Osage, Stephen, Carter, Garvin, and Creek counties led as producers, in the order listed. The decrease from 83,594 wells in 1960 resulted from plugging of wells by the U.S. Corps of Engineers on land to be inundated by Oologah Reservoir on the Verdigris River in Rogers County. Unallocated fields, which included secondary-recovery proj-

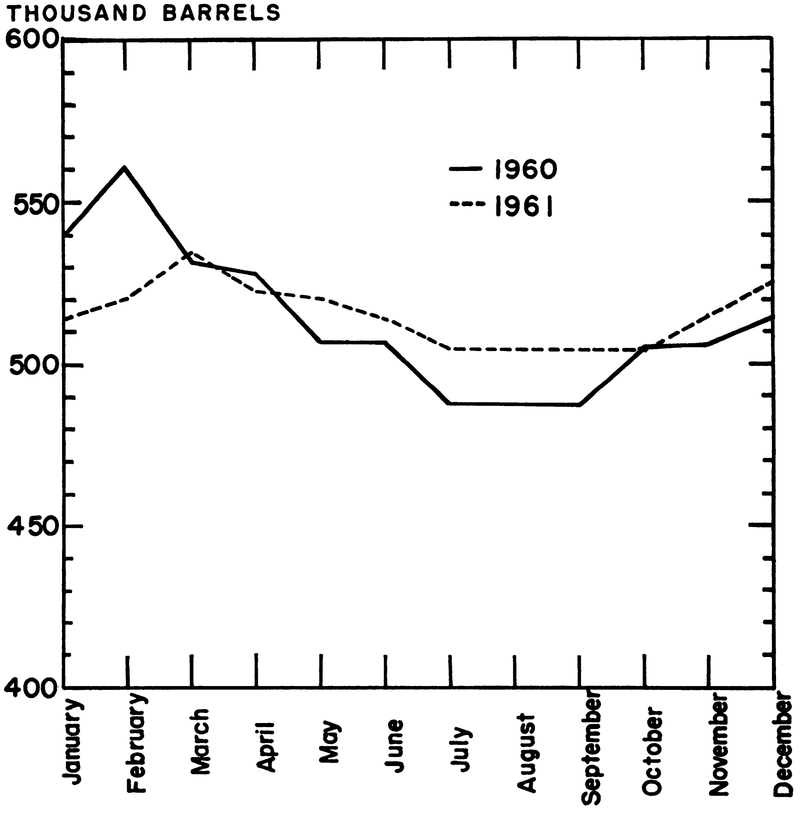

FIGURE 1.—Petroleum allowable production in thousand barrels per day established by the Oklahoma Corporation Commission, 1960–61.

TABLE 7.—Crude petroleum production

(Thousand barrels and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	199,507	$543,379	1959	198,090	$578,423
1957	214,661	650,423	1960	192,913	563,306
1958	200,699	594,069	1961 [1]	191,834	558,237

[1] Preliminary figures.

TABLE 8.—Crude petroleum production, indicated demand, and stocks, in 1961, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks originating in Oklahoma
January	16,731	17,046	16,691
February	15,253	15,024	16,920
March	16,985	16,765	17,140
April	16,385	15,348	18,177
May	16,389	16,021	18,545
June	15,173	15,618	18,100
July	15,459	15,445	18,114
August	15,999	17,430	16,683
September	15,412	15,945	16,150
October	16,054	15,651	16,553
November	15,246	14,771	17,028
December	16,748	15,976	17,800
Total:			
1961[1]	191,834	191,040	----------
1960	192,913	194,320	----------

[1] Preliminary figures.

TABLE 9.—Crude petroleum production by fields

(Thousand barrels)

Field[1]	1957	1958	1959	1960	1961[2]
Allen	1,608	1,590	1,676	1,525	1,403
Beebe	707	625	606	697	749
Bradley	3,053	2,741	2,898	2,631	3,048
Burbank	14,280	14,548	14,463	15,676	15,275
Cache Creek	721	827	910	1,041	1,231
Cement	4,061	4,405	4,222	3,836	4,038
Cumberland	1,812	1,474	1,407	1,219	1,213
Cushing	2,650	2,702	2,585	2,515	2,537
Davenport	1,289	959	855	613	654
Dilworth	677	517	453	(3)	(3)
Doyle	2,798	2,421	2,241	1,798	1,671
Elk City	4,078	2,806	2,113	1,741	1,398
Eola	3,886	3,188	3,863	3,470	3,624
Fitts	723	800	910	950	983
Garber	849	826	876	761	595
Glenn Pool	2,259	2,773	3,164	3,200	3,368
Golden Trend	17,245	13,106	10,627	11,071	10,202
Grand Valley	----------	----------	----------	----------	1,942
Healdton	2,260	2,331	2,256	2,154	2,353
Hennessey	----------	----------	----------	----------	2,899
Hewitt	3,240	3,084	2,977	2,938	2,989
Holdenville-East	628	476	412	(3)	(3)
Hoover-Northwest	1,863	2,417	2,039	1,329	802
Joiner City	----------	----------	395	1,561	2,054
Knox	1,232	1,045	941	2,206	2,039
Loco	1,542	1,372	1,290	1,309	1,517
Lucien	817	743	749	710	699
Moore-West	3,250	2,553	1,527	1,275	1,294
Naval Reserve	1,409	1,498	1,667	2,353	2,456
Oklahoma City	3,482	3,290	3,050	2,851	2,617
Olympic	1,573	1,341	1,101	967	787
Payson-East	467	300	423	893	1,421
Seminole:					
Bowlegs	655	619	665	905	1,125
Little River	478	430	390	388	354
St. Louis	1,443	1,410	1,379	1,422	1,449
Seminole	912	876	797	696	666
Sho-Vel-Tum	29,008	25,823	25,175	24,227	24,510
West Edmond	1,292	1,153	1,013	1,407	1,012
Yale-Quay	1,765	1,927	1,700	1,254	979
Other fields[4]	94,649	91,703	94,275	89,324	83,681
Total Oklahoma	214,661	200,699	198,090	192,913	191,834

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[1] Breakdown for individual fields from the Oil and Gas Journal.
[2] Preliminary figures.
[3] Included with "Other fields."
[4] Bureau of Mines figures.

ects and stripper wells, accounted for 60 percent of the State output.

The Interstate Oil Compact Commission, in cooperation with the Independent Petroleum Association of America and the National Stripper Well Association, reported that on January 1, 1961, Oklahoma had 65,688 stripper wells which produced over 95 million barrels of oil in 1960. Oil reserves of the stripper wells totaled 1.2 billion barrels, or 67 percent of the overall proved oil reserve in Oklahoma on January 1.

The average price per barrel of Oklahoma crude petroleum at the wellhead was $2.91 in 1961, down from $2.92 in 1960.

Oklahoma again ranked third in test-well drilling with 529 test wells (96 oil productive and 52 gas productive), compared with 700 in 1960. Test-well drilling totaled 2,816,413 feet—an average of 5,324 feet per well in 1961, up from 5,133 feet in 1960. The 5,316 field-development wells drilled totaled 17,515,995 feet—an average of 3,294 feet per well, considerably less than in 1960, when the well depth averaged 3,374 feet.

Primary drilling was directed to field wells although several counties attracted attention for exploratory drilling. In the northeastern section (Kay, Noble, and Osage Counties), 48 exploratory tests produced 7 oil wells and 2 gas wells; in the central section (Blaine, Kingfisher, and Lincoln Counties), 54 attempts yielded 18 oil wells, 2 condensate wells, and 10 gas wells; in the Panhandle (Beaver and Texas Counties), 40 exploratory tests yielded 9 oil wells and 7 gas wells; in the north central section (Alfalfa, Garfield, and Major Counties), 44 exploratory tests produced 16 oil wells, 3 condensate wells, and 4 gas wells; and west of the Arbuckle Mountains (Stephens County), 16 attempts produced only 2 oil wells and 1 gas well.

The value of petroleum produced in Kingfisher County was $13,790,400, or 386 percent greater than in 1960; it reflected increased drilling in the Anadarko Basin during the past 4 years. The Dover field was developed until it connected with the Hennessey field in 1961.

TABLE 10.—Oil and gas wells drilled in 1961, by counties

County	Proved field wells				Exploratory wells			Total
	Oil	Gas	Service	Dry	Oil	Gas	Dry	
Alfalfa	6	1	--------	4	4	--------	7	22
Atoka	--------	--------	--------	--------	1	--------	--------	1
Beaver	96	91	7	55	4	5	9	267
Beckham	1	10	--------	10	1	--------	5	27
Blaine	1	6	--------	4	2	5	3	21
Bryan	2	--------	--------	1	--------	--------	1	4
Caddo	51	2	--------	8	--------	1	4	66
Canadian	--------	--------	--------	1	--------	--------	1	2
Carter	130	2	6	41	2	--------	12	193
Cimarron	2	8	--------	7	--------	1	--------	18
Cleveland	21	2	1	11	3	--------	11	49
Coal	--------	2	1	2	--------	--------	5	10
Comanche	20	4	2	11	1	1	6	45
Cotton	15	--------	20	8	--------	--------	8	51
Craig	5	--------	--------	5	--------	--------	2	12
Creek	253	3	195	49	1	--------	1	502
Custer	--------	1	--------	--------	2	--------	--------	3
Delaware	--------	--------	--------	--------	--------	--------	1	1
Dewey	4	9	--------	2	2	--------	3	20
Ellis	4	21	--------	18	1	2	3	49
Garfield	50	2	14	24	10	--------	8	108
Garvin	27	7	13	57	4	--------	4	112

TABLE 10.—Oil and gas wells drilled in 1961, by counties—Continued

County	Proved field wells				Exploratory wells			Total
	Oil	Gas	Service	Dry	Oil	Gas	Dry	
Grady	8	1	--------	7	2	--------	1	19
Grant	41	1	1	9	1	--------	4	57
Greer	2	--------	--------	--------	--------	--------	1	3
Harper	11	31	--------	13	--------	1	4	60
Haskell	--------	8	--------	3	--------	3	2	16
Hughes	19	8	7	27	--------	3	9	73
Jackson	--------	--------	--------	2	--------	--------	2	4
Jefferson	29	3	1	10	--------	--------	10	53
Johnston	--------	--------	--------	--------	--------	--------	2	2
Kay	42	12	4	16	3	--------	15	92
Kingfisher	354	13	--------	7	17	3	11	405
Kiowa	10	--------	--------	25	1	--------	14	50
Latimer	--------	8	--------	1	--------	1	2	12
LeFlore	--------	4	--------	--------	--------	2	4	10
Lincoln	51	31	10	38	1	2	10	143
Logan	5	7	1	4	--------	1	7	25
Love	10	1	--------	12	1	--------	7	31
Major	19	10	--------	11	5	4	6	55
Marshall	8	--------	2	15	--------	--------	2	27
Mayes	--------	--------	--------	--------	--------	--------	1	1
McClain	56	3	--------	8	2	--------	5	74
McCurtain	--------	--------	--------	5	--------	--------	1	6
McIntosh	--------	2	--------	5	--------	1	4	12
Murray	5	--------	--------	2	1	--------	5	13
Muskogee	135	1	5	50	1	1	4	197
Noble	31	15	--------	18	2	1	9	76
Nowata	119	3	44	42	1	1	1	211
Okfuskee	89	15	4	42	3	1	8	162
Oklahoma	5	--------	1	1	--------	--------	1	8
Okmulgee	93	11	43	43	--------	--------	1	191
Osage	171	9	115	77	2	1	15	390
Pawnee	26	--------	13	7	--------	--------	6	52
Payne	8	3	4	10	1	--------	3	29
Pittsburg	--------	1	--------	3	--------	4	9	17
Pontotoc	18	2	5	18	2	--------	8	53
Pottawatomie	66	--------	10	33	2	--------	11	122
Pushmataha	--------	--------	--------	--------	--------	1	6	7
Roger Mills	--------	--------	--------	--------	--------	--------	1	1
Rogers	62	11	17	61	1	--------	2	154
Seminole	91	8	7	45	2	2	7	162
Sequoyah	--------	3	--------	1	--------	--------	--------	4
Stephens	118	7	84	52	2	1	13	277
Texas	49	41	2	40	5	2	15	154
Tillman	5	--------	1	7	--------	--------	6	19
Tulsa	79	6	44	56	--------	--------	--------	185
Wagoner	50	4	11	81	--------	--------	--------	146
Washington	230	2	78	45	--------	--------	--------	355
Washita	--------	1	--------	--------	--------	--------	4	5
Woods	--------	1	2	2	--------	--------	14	19
Woodward	--------	4	--------	4	--------	1	14	23
Total: 1961	[1] 2,803	462	775	1,276	[1] 96	52	381	5,845
1960	[1] 2,208	369	540	985	[1] 148	65	487	4,802

[1] Includes distillate wells.

Source: Oil and Gas Journal, v. 60, No. 5, Jan. 29, 1962, pp. 184, 187.

The Dover-Hennessey field—15 miles long and 4 to 5 miles wide—contained estimated reserves of 500 million barrels. Unlike other fields, the Dover-Hennessey had been developed within the bounds of conservation, with one well set on each 80 acres. The Golden Trend and Antioch pools in Garvin County were linked by a dual oil-gas well in the First and Second Bromide sands.

On January 1, Oklahoma had 15 refineries with a total daily capacity of 409,680 barrels of crude oil and 152,185 barrels of cracked gasoline. The refineries processed about 68 percent of the State production. Crude oil runs to stills, compared with total receipts, intrastate receipts, and yearend stocks at Oklahoma refineries for 1960 and 1961, in thousand barrels, were as follows:

Year	*Runs to stills*	*Total receipts*	*Intrastate receipts*	*Stocks Dec. 31*
1960	131,042	130,820	93,073	2,522
1961	130,276	129,788	93,387	2,021

Plant facilities for the first carbonated waterflood in Osage County were completed by Cities Service Petroleum Co. in the Domes field 12 miles west of Bartlesville. The Orco Process used at the project utilized water and carbon dioxide mixed at the bottom of each injection well.

The Bartlesville Petroleum Research Center of the Federal Bureau of Mines conducted research on petroleum production problems. Three reports of interest to the industry were published. Hydraulic-fracturing treatments in waterfloods were successful in stimulating production from oil wells and increasing the rate of injection into input wells.[4]

Sodium tripolyphosphate (STP)—a common detergent—when added in minute proportions to the injected water, keeps injection wells free of corrosion and plugging, thereby eliminating costly periodic shutdowns. Research showed that STP was the cheapest and most available of the polyphosphates and worked satisfactorily with certain brines.[5]

Developments in waterflooding and pressure maintenance in Osage County oilfields were described. Waterflooding was tried as early as 1934, but it was not economically important until activation of a large unitized flood in the North Burbank field in 1950. Rapid development followed, and a decade later, 70 waterflood and 16 pressure-maintenance projects were active.[6]

NONMETALS

The 10 nonmetals produced in 1961 were valued at $42.6 million, 5 percent of the State's total mineral production value. Cement, stone, sand and gravel, gypsum, and clays were the five principal nonmetal commodities. Cement, clays, gypsum, lime, and stone increased in quantity and value; however, the output of pumice, sand and gravel, and tripoli decreased.

Dewey Portland Cement Co., Division of American-Marietta Co., dedicated its new $12 million, 1.25-million-barrel-per-year cement plant northeast of Tulsa in June. Oklahoma Cement Co. revealed plans, in September, to double the capacity of its 1-million-barrel-per-year plant southeast of Pryor. In October, Dewey Portland Cement Co. ceased production of cement at its Dewey plant for the remainder of the year due to plant surpluses, a seasonal construction slump, and general business conditions.

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[4] Powell, John P., and Kenneth H. Johnston. Effects of Hydraulic Fracturing in Oklahoma Waterflood Wells. BuMines Rept. of Inv. 5713, 1961, 21 pp.

[5] Johansen, R. T., and H. N. Dunning. Relative Wetting Tendencies of Crude Oils by Capillarimetric Method. BuMines Rept. of Inv. 5752, 1961, 11 pp.

[6] Johnston, Kenneth H., and Joe L. Castagno. Developments in Waterflooding and Pressure Maintenance in Osage County, Okla., Oilfields, 1961. BuMines Inf. Circ. 8038, 1961, 38 pp.

A 5-year study of maintenance costs between asphaltic concrete and portland cement completed by the State highway department, revealed that the portland cement section was more durable and less expensive to maintain. Authorized by the 1953 State Legislature, a 4-mile checkerboard pattern was constructed on U.S. 77 north of Oklahoma City for the test period, January 1, 1956, to December 31, 1960.

A $1.5 million furnace rebuilding and expansion program was underway early in the year at Ball Brothers glass plant in Okmulgee; construction of a warehouse was included in the program. An addition to plant facilities completed by Corning Glass Works increased its Muskogee plant capacity by 50 percent.

Southwestern Gypsum Co. began open-pit operations in August from a gypsum deposit in the Cloud Chief formation near Weatherford, reported to contain 1.3 billion tons of gypsum.[7] The gypsum, crushed and ground to 200-mesh, was sold for agricultural purposes. Another deposit, also in the Cloud Chief formation, operated by Southwestern Gypsum Co. near Colony was closed during the year.

A new firm, Tulsa Rock Co., built a $1.5 million crushed stone plant at Tulsa, capable of handling about 300 tons per hour.

Cement.—Three cement companies at four locations produced 45 percent more cement than in 1960. Shipments of cement into the State increased 19 percent. Plants at Ada, Pontotoc County, and Pryor, Mayes County, were active throughout the year. The plant of Dewey Portland Cement Co., at Dewey, Washington County, was inactive at yearend, and the company's new plant in Rogers County, northeast of Tulsa, was active from midyear.

TABLE 11.—Shipments of portland cement to Oklahoma consumers

Year	Thousand barrels	Change, percent	
		In Oklahoma	In United States
1952–56 (average)	4,556		
1957	4,886	+1	−6
1958	5,131	+5	+6
1959	5,374	+5	+9
1960	4,669	−13	−7
1961	5,573	+19	+3

Clays.—Clay was produced primarily for manufacturing brick and tile and, to a lesser extent, for portland cement and lightweight expanded clay products. Brick and tile were produced in Creek, Custer, Garfield, Greer, Lincoln, Oklahoma, Pittsburg, Pontotoc, Rogers, Seminole, and Tulsa Counties; lightweight aggregate was made in Oklahoma and Rogers Counties; and pottery was manufactured in Creek County. Bentonite, produced in Dewey County, was used for filtering and as an absorbent.

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[7] Ham, William E., Neville M. Curtis, Jr. Gypsum in the Weatherford-Clinton District, Oklahoma. Okla. Geol. Survey Report 35, June 1958, 32 pp.

TABLE 12.—Clays sold or used by producers [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	593	$755	1959	966	$970
1957	641	642	1960	734	739
1958	576	579	1961	792	801

[1] Excludes bentonite.

Gem Stones.—Individuals sold small quantities of gem-quality stones, essentially crystalline specimens of barite, calcite, marcasite, and quartz collected in Cleveland, McCurtain, Ottawa, and Pontotoc Counties.

Gypsum.—Output of gypsum rose nearly 5 percent above 1960, reflecting increased demand for gypsum building products. Most of the crude gypsum was mined by 3 companies in Blaine County, where United States Gypsum Co. operated quarries and a plant at Southard to manufacture wallboard and plaster products. Gypsum also was produced in Caddo, Washita, and Custer Counties.

Lime.—St. Clair Lime Co. produced lime in Sequoyah County. Output of the plant, up 34 percent from 1960, was principally consumed by chemical plants at Pryor and by municipal water plants.

Pumice.—Pumice, produced in Beaver County, dropped 9 percent and was used primarily in abrasive-type cleansers. The deposit consists of unconsolidated volcanic ash.

Salt.—Salt was produced in Harmon County by solar evaporation of brine from springs, and in Woods County from surface incrustations on the Big Salt Plain of the Cimarron River. Major uses of the finished product were for stockfeed and recharging of water softeners; minor uses included herbicides and salinity control of oil-well-drilling fluid.

Sand and Gravel.—Sand and gravel was produced in 43 counties; Tulsa, Pontotoc, Johnston, Muskogee, Oklahoma, and Pushmataha Counties supplied 63 percent of the quantity and 74 percent of the value. Most of the sand was used as building sand, high-purity glass sand, and paving sand. In lesser quantities, sand was used for molding, pottery and tile, abrasives, blasting, filtration, and engine, chemical, foundry, and other purposes. Most of the gravel was used for paving and building.

Stone.—Output of stone, including limestone used in manufacture of cement and lime, increased 6 percent over 1960. The five leading stone producing counties in order of value were Tulsa, Comanche, Pontotoc, Murray, and Pittsburg Counties; they accounted for more than one-half of the stone produced.

Of total stone output, limestone comprised 84 percent and sandstone 8 percent; the remaining 8 percent was distributed among granite and miscellaneous stone—primarily chat. About 84 percent of the stone production was crushed and used principally for roadstone, concrete aggregate, cement, and lime. All stone was produced by open-pit methods except that from two underground mines in eastern Oklahoma. Railroads moved 21 percent of stone shipments; trucks, 44 percent; and unspecified transportation, 35 percent.

TABLE 13.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	3,126	$3,224	2,163	$989	5,289	$4,213
1957	3,297	3,608	1,663	899	4,960	4,507
1958	4,245	4,417	2,987	1,442	7,232	5,859
1959	4,376	4,988	1,626	939	6,002	5,927
1960	4,823	6,544	1,601	924	6,424	7,468
1961	4,029	4,515	1,281	998	5,310	5,513

TABLE 14.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,586	$1,377	1,690	$1,352
Paving	1,151	1,448	885	732
Fill	335	160	392	203
Other [1]	661	1,817	480	1,642
Total	3,733	4,802	3,447	3,929
Gravel:				
Building	157	168	79	102
Paving	927	1,571	493	479
Other [2]	6	3	10	5
Total	1,090	1,742	582	586
Total sand and gravel	4,823	6,544	4,029	4,515
Government-and-contractor operations:				
Sand:				
Building			351	431
Paving	980	474	419	249
Other			8	7
Total	980	474	778	687
Gravel:				
Paving	621	450	499	309
Fill			4	2
Total	621	450	503	311
Total sand and gravel	1,601	924	1,281	998
Grand total	6,424	7,468	5,310	5,513

[1] Includes glass, molding, filtering, and other construction, industrial, and ground sand.
[2] Includes railroad ballast and miscellaneous gravel.

Chat.—Chat—the coarse tailing from milling lead and zinc ores in the Tri-State District—is essentially chert (microcrystalline silica) with small quantities of limestone, galena, sphalerite, marcasite, and pyrite. Most of the chat was sold for railroad ballast, concrete aggregate, and road surfacing.

Granite.—Four producers operated five quarries in the Wichita Mountains area of Greer and Kiowa Counties—center of the State's

TABLE 15.—Sand and gravel production in 1961, by counties

(Short tons)

County	Quantity	Value	County	Quantity	Value
Alfalfa	18,700	$13,852	McIntosh	283	$122
Atoka	35,570	14,384	Marshall	1,125	450
Blaine	22,000	26,000	Murray	144,823	72,697
Bryan	117,183	97,151	Noble	28,809	21,607
Caddo	75,000	30,000	Oklahoma	309,156	401,199
Canadian	160,300	64,120	Osage	1,770	708
Carter	13,560	6,785	Ottawa	990	396
Cherokee	660	330	Pawnee	83,319	50,655
Cotton	62,175	31,088	Pittsburg	8,283	7,122
Garvin	17,333	7,133	Pushmataha	264,311	310,914
Greer	152,133	86,920	Sequoyah	13,469	22,778
Jackson	30,000	32,500	Texas	57,775	69,000
Kay	129,948	118,726	Tillman	18,923	8,119
Kiowa	85,805	69,822	Tulsa	1,589,280	1,128,561
Latimer	4,100	1,640	Woods	11,340	5,670
LeFlore	1,125	450	Woodward	15,750	13,975
Logan	1,080	1,000	Other counties [1]	1,799,641	2,781,282
Love	11,253	5,467			
McClain	14,985	6,794	Total	5,310,085	5,512,668
McCurtain	8,128	3,251			

[1] Includes Choctaw, Grady, Johnston, Kingfisher, Major, Muskogee, and Pontotoc Counties, combined to avoid disclosing individual company confidential data.

dimension-granite industry. Output, which was 13 percent higher than in 1960, came from Precambrian granites—predominantly pink and red. Dimension granite was used for monumental stone; most of this granite was finished in plants within the area; however, some was shipped as rough rock to other States.

Limestone and Dolomite.—Limestone and dolomite were quarried in 35 counties; Tulsa, Comanche, and Murray Counties reported the greatest output.

Chemical-grade limestone quarried at Marble City, Sequoyah County, was used for limemaking and agricultural purposes. Over 2,700 tons of dimension limestone was quarried for building stone, curbing, and flagging in Caddo, Johnston, and Pontotoc Counties. Limestone for portland cement was quarried in Pontotoc, Washington, Rogers, and Mayes Counties.

Dolomite was produced in Johnston County for use as flux in glass manufacturing and as a soil conditioner.

TABLE 16.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Granite		Limestone		Sandstone		Other stone		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1957	[1] 5	[1] $557	[2] 10,238	[2] $12,041	306	$373	1,467	$1,093	12,016	$14,064
1958	31	569	9,383	10,833	275	264	1,105	566	10,794	12,232
1959	[1] 5	720	11,242	13,455	222	241	1,214	564	12,683	14,980
1960	[3] 5	620	11,995	13,852	784	870	1,270	756	[3] 14,054	[3] 16,098
1961	22	681	12,531	13,712	1,133	1,529	1,295	639	14,981	16,561

[1] Crushed granite included with "Other stone."
[2] Dimension limestone included with "Other stone."
[3] Excludes crushed granite.

Sandstone.—Sandstone was quarried and crushed in 11 counties for use by the State Highway Department and U.S. Army Corps of Engineers, Tulsa District.

Sulfur.—Central Chemical Co., Madill, Marshall County, recovered sulfur from refinery offgas of sour crudes.

Tripoli.—Tripoli output in eastern Ottawa County declined 14 percent. The crude material was processed at Seneca, Mo., by American Tripoli Division of The Carborundum Co. and sold largely for buffing compounds and to a small extent for use in foundries.

Vermiculite.—The Texas Vermiculite Co. exfoliated vermiculite at its plant in Oklahoma County from material mined in other States. The product was used primarily in concrete and plaster.

Water.—In an effort to solve an old water-pollution problem on Pryor Creek, three industries—Bestwall Products Co., National Gypsum Co., and John Deere Chemical Co.—formed Pryor Industrial Conservation Corp. to build and operate a $500,000 industrial waste-disposal system to control the rate of discharge into Grand River in Mayes County. The system comprised 4.5 miles of pipeline connecting the three plants with two hold lagoons and the Grand River. Automatic control, proportioned to the streamflow, was to assure adequate and safe diffusion at all stream levels upon completion of the system in early 1962.

At yearend, three multimillion-dollar dam projects of the U.S. Army Corps of Engineers, Tulsa District, were in various stages of construction. The Eufaula Dam, under construction on the South Canadian River between Haskell and McIntosh Counties, 12 miles east of Eufaula, was about 44-percent complete. Completion of the $125 million project was scheduled for 1965. Keystone Dam, under construction on the Arkansas River in Tulsa County, 15 miles west of Tulsa, was nearly 52-percent complete. The $107 million project was scheduled to be completed in 1965. The Oologah Dam, under construction on the Verdigris River in Rogers County, 27 miles northeast of Tulsa, was almost 95-percent complete. Completion of the $35.1 million project was scheduled for late 1962. The Oologah Dam will be a principal unit in the overall plan for flood control, generation of hydroelectric power, navigation, and allied water uses on the Arkansas River and its tributaries.

Work began on the $15.8 million Broken Bow Dam on Mountain Fork River in McCurtain County. About 6-percent completed at yearend, the dam was scheduled to be finished in 1965.

Bank-stabilization to prevent meandering of the Arkansas River and halve migration of bends and caving banks was about 75-percent complete. The work was conducted on a 33.4-mile segment extending from the site of the Short Mountain Dam and lock in eastern Oklahoma to the Arkansas border near Fort Smith.

Late in 1961, the Grand River Dam Authority sold a $50 million bond issue to finance construction of the Markham Ferry Dam and powerplant on Grand River southeast of Pryor in Mayes County.

The U.S. Army Corps of Engineers, Tulsa District, was in its 2d year of studies aimed at diminishing the salt water in the Arkansas River and its principal tributaries—the Cimarron and Salt Fork—and the tributaries of the Red River. According to an Oklahoma

Water Resources Board report in April, enough salt daily entered the Arkansas River to fill a 94-car freight train.

Many Oklahoma cities were seeking extra water supplies. Some projects were joint undertakings between communities. In addition to the four Corps of Engineers dams mentioned previously, Pine Creek Dam, on the Little River in McCurtain County, and Sand Dam, on Sand Creek in Osage County, were under construction or had been authorized by Congress.

Similarly authorized or under construction were six projects directed by the Federal Bureau of Reclamation; these included the Arbuckle, Fort Cobb, Foss, Mountain Park, Norman, and Waurika projects. The Arbuckle Dam was planned to supply water, flood-control, and recreation facilities on Rock Creek, a tributary of the Washita River in Murray County. Water would be provided for Ardmore, Davis, Sulphur, Wynnewood, the Ardmore airfield and industrial park, and the Kerr-McGee Oil Industries refinery near Wynnewood. The Fort Cobb Dam on Cobb Creek, a tributary of the Washita River in Caddo County, was to provide water for Fort Cobb and Anadarko and Western Farmers Electric Co-op. Foss Dam, on Washita River in Custer County, was a participating project with the towns of Clinton, Hobart, Cordell, and Bessie, and the Clinton-Sherman Air Force Base. Mountain Park Dam, on Otter Creek in Kiowa County, was to provide water for Altus, Mountain Park, Tipton, Frederick, and Snyder. Norman Dam, on the Little River system in Cleveland County, was a participating project among Norman, Del City, and Midwest City. Waurika Dam on Beaver Creek in Jefferson County was to provide, in a sharing project, water to Waurika, Lawton, Comanche, Duncan, Temple, and Walters.

METALS

Output of lead and zinc increased, owing in part to anticipation of subsidy payments to small lead and zinc producers—legislation which was later signed into law effective January 1, 1962.

TABLE 17.—Mine production of lead and zinc, in terms of concentrate and recoverable metals[1]

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content[2]			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1952–56 (average)	17,843	$3,162	75,957	$6,441	13,024	$3,858	40,112	$10,600
1957	10,198	1,896	27,702	2,288	7,183	2,054	14,951	3,469
1958	5,213	689	9,791	594	3,692	864	5,267	1,074
1959	905	118	2,090	134	601	138	1,049	241
1960	1,687	155	4,715	344	936	219	2,332	602
1961	1,333	130	5,936	405	980	202	3,148	724
Total, 1891–1961	1,676,731	162,964	9,744,301	483,015	1,285,668	194,613	5,137,644	773,306

[1] Based on Oklahoma ore (dirt) and old tailing treated at mills during calendar year indicated.

[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, it should be noted that value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

TABLE 18.—Tenor of lead-zinc ore milled and concentrates produced[1]

	1960	1961
Total material milled .... short tons..	19,700	80,232
Recovery of concentrate and metal from quantity milled:		
Galena .... short tons..	534	1,219
Sphalerite .... do....	2,010	5,688
Galena .... percent..	2.71	1.52
Sphalerite .... do....	10.20	7.09
Lead[2] .... do....	1.73	1.15
Zinc[2] .... do....	5.28	3.78
Average lead content of galena concentrate .... do....	64.98	77.28
Average zinc content of sphalerite concentrate .... do....	57.56	59.28
Average value per ton:		
Galena concentrate	$114.19	$100.55
Sphalerite concentrate	$76.38	$68.67

[1] Lead-zinc concentrates from accumulated slimes excluded.
[2] Figures represent metal content of crude ore (dirt) as recovered in concentrate. Data on tailing losses not available.

TABLE 19.—Mine production of lead and zinc in 1961, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc	Month	Lead	Zinc
January	36	162	August	69	184
February	39	67	September	70	235
March	31	37	October	96	462
April	63	99	November	205	597
May	47	161	December	230	887
June	41	109			
July	53	148	Total	980	3,148

TABLE 20.—Quoted prices on 60 percent zinc concentrate and 80 percent lead concentrate at Joplin, Mo., in 1961

Zinc concentrate		Lead concentrate	
Period	Price per short ton	Period	Price per short ton
Jan. 1-Jan. 8	$72.00	Jan. 1-Nov. 5	$125.16
Jan. 9-Dec. 3	68.00	Nov. 6-Nov. 12	117.96
Dec. 4-Dec. 31	72.00	Nov. 13-Nov. 23[1]	110.76

[1] Lead quotation discontinued.

Source: E&MJ Metal & Mineral Markets.

Germanium.—Germanium, recovered as a residue in zinc smelting, was obtained from domestic and foreign zinc ore concentrate by The Eagle-Picher Co. at Henryetta, Okmulgee County, and National Zinc Co. at Bartlesville, Washington County. The residue was shipped to the new germanium processing plant of The Eagle-Picher Co. north of Quapaw, Ottawa County.

Lead.—Many mines were reopened in 1961 as 21 producers (3 producers in 1960) reported lead output. Despite an increase of 5 percent in recoverable lead mined in Ottawa County, the market was depressed, as evidenced by an 8 percent drop in value. The price of lead, New York, on January 1 was 11 cents per pound. The price dropped to 10.5 cents per pound on November 1, and to 10 cents per pound on November 13. Effective November 28, the price increased to 10.25 cents.

Zinc.—Output of recoverable zinc in Ottawa County increased 35 percent in tonnage and 20 percent in value compared with 1960. Mines that had been closed for several years reopened, for there were 21 zinc producers in 1961, compared with 3 in 1960.

The price of zinc metal on January 1 was 12 cents per pound, East St. Louis. It dropped to 11.5 cents per pound on January 10 and remained unchanged until December 1, when a slight increase occurred. On December 4, the price rose to 12 cents.

Custom Mills and Smelters.—American Metal Climax, Inc., at Blackwell, Kay County; The Eagle-Picher Co. at Henryetta, Okmulgee County; and National Zinc Co. at Bartlesville, Washington County, operated horizontal-retort zinc plants throughout 1961. Domestic and foreign ores and concentrates were treated at the smelters. Federated Metals Division of American Smelting & Refinery Co. operated a secondary zinc plant in Sand Springs, Tulsa County.

American Zinc, Lead & Smelting Co. reopened its Barbara J. mill near Cardin early in the year. The Eagle-Picher Co. reopened its Central mill for custom milling of Tri-State ores.

Sulfuric acid was recovered as a byproduct from imported zinc ores processed by National Zinc Co. at its plant in Bartlesville, Washington County.

The closing of American Smelting & Refinery Co.'s Federal smelter at East Alton, Ill., and cessation of custom lead smelting at St. Joseph Lead Co.'s Herculaneum smelter, Jefferson County, Mo., resulted in a loss of markets for lead concentrate in the entire midcontinent area.

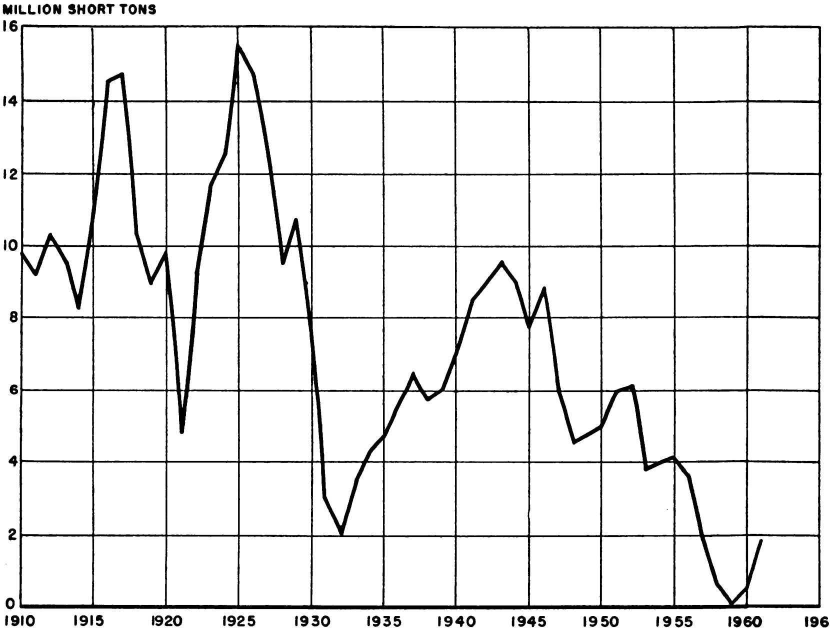

FIGURE 2.—Quantity of crude ore (rock) milled in the Tri-State District, 1910–61.

TRI-STATE DISTRICT

Depressed lead-zinc markets, which led to a general shutdown in mid-1958 of all major mining operations in the Tri-State District, continued in 1961. However, the quantities of lead and zinc concentrates recovered rose 5 and 20 percent, respectively, over the quantities recovered in 1960. Despite the increased output and the number of mines reopened in anticipation of the Government's lead-zinc program, return of large-scale mining to the Tri-State District was doubtful. Oklahoma produced 41 percent of the district's lead concentrate and 56 percent of its zinc concentrate; Kansas produced 59 percent of the district's lead concentrate and 44 percent of the zinc concentrate. No output was reported from southwest Missouri.

TABLE 21.—Mine production of lead and zinc concentrates in Tri-State District, in terms of concentrate and recoverable metals

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1952–56 (average)	26, 764	$4, 850	127, 274	$10, 973	19, 799	$5, 913	67, 495	$17, 917
1957	15, 930	2, 928	57, 052	4, 604	11, 462	3, 278	30, 895	7, 168
1958	7, 041	931	18, 001	1, 093	4, 991	1, 168	9, 688	1, 976
1959	1, 607	211	4, 061	282	1, 082	249	2, 066	475
1960	3, 098	284	8, 877	658	1, 717	402	4, 449	1, 148
1961:								
Kansas	1, 910	222	4, 730	311	1, 449	298	2, 446	563
Southwest Missouri	--------	--------	--------	--------	--------	--------	--------	--------
Oklahoma	1, 333	130	5, 936	405	980	202	3, 148	724
Total: 1961	3, 243	352	10, 666	716	2, 429	500	5, 594	1, 287

TABLE 22.—Tenor of lead and zinc ore milled and concentrate produced in the Tri-State District

	1957	1958	1959 [1]	1960 [1]	1961 [1]
Total material milled: Crude ore ... short tons	1, 836, 942	611, 556	31, 750	51, 972	180, 331
Recovery of concentrate and metal from material milled:					
Galena ... percent	0. 87	1. 15	2. 58	1. 85	1. 67
Sphalerite ... do	3. 11	2. 94	6. 71	7. 79	5. 64
Lead [2] ... do	0. 62	0. 82	2. 05	1. 18	1. 28
Zinc [2] ... do	1. 68	1. 58	3. 54	4. 13	2. 98
Average lead content of galena concentrate ... do	73. 46	72. 35	81. 17	64. 86	78. 43
Average zinc content of sphalerite concentrate ... do	60. 16	59. 76	58. 54	58. 88	58. 65
Average value per ton:					
Galena concentrate	$183. 80	$132. 29	$154. 95	$113. 62	$111. 82
Sphalerite concentrate	$80. 70	$60. 74	$73. 49	$78. 40	$67. 56

[1] Lead-zinc concentrates from accumulated slimes excluded.

[2] Figures represent metal content of the crude ore (dirt) as recovered in concentrate.

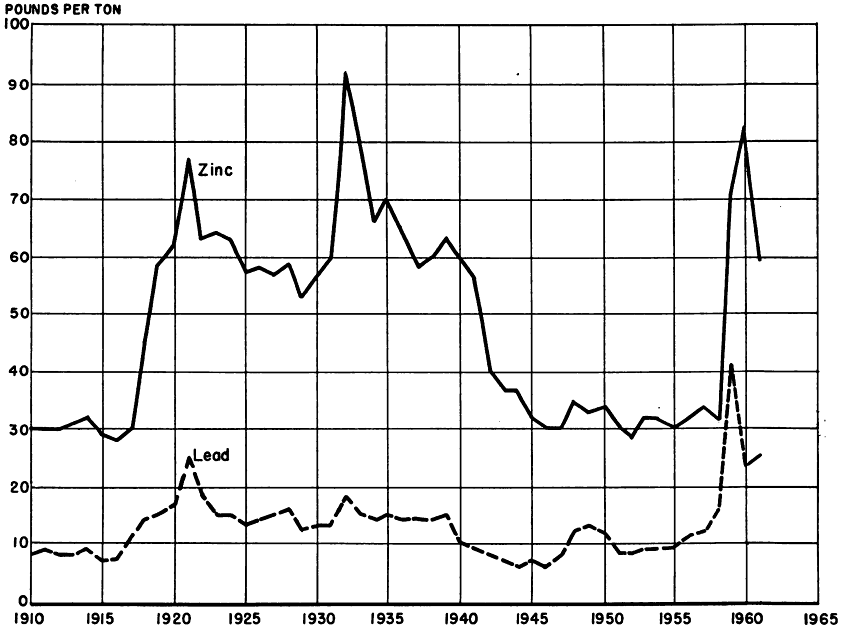

FIGURE 3.—Metal recovered per ton of crude ore (rock) milled in the Tri-State District, 1910–61.

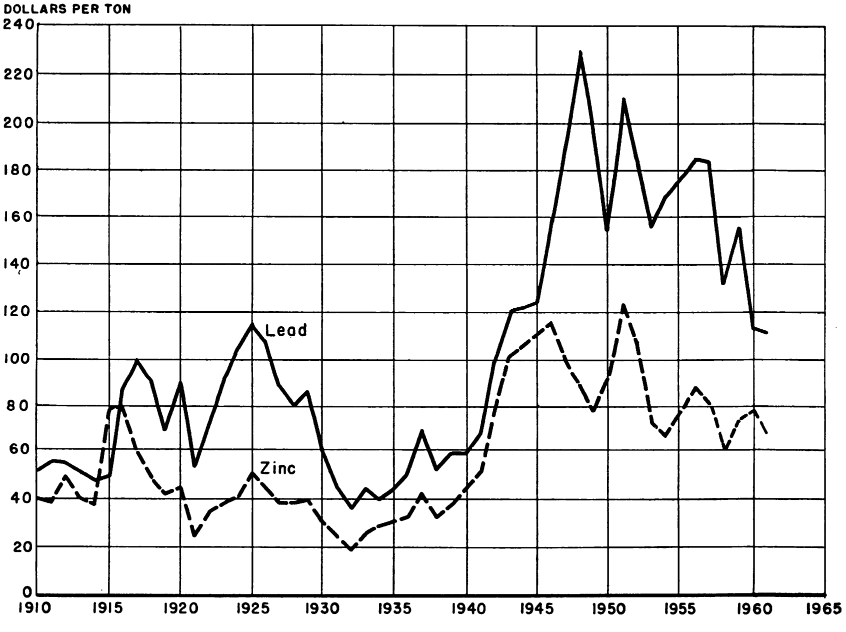

FIGURE 4.—Average prices received by sellers per ton of concentrate in the Tri-State District, 1910–61.

REVIEW BY COUNTIES

Output of metals, nonmetals, and mineral fuels was reported from 75 of Oklahoma's 77 counties. Only those counties with significant production are discussed in this review (see table 23 for additional details).

Atoka.—Limestone was mined and crushed at the Southwest Stone Co. quarry near Stringtown for use as roadstone, concrete aggregate, and riprap. Sand and gravel was produced by the State highway department.

TABLE 23.—Value of minerals produced in Oklahoma, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Adair	$39, 352	$68, 958	Petroleum.
Alfalfa	3, 349, 615	3, 138, 496	Petroleum, natural gas, sand and gravel.
Atoka	(2)	(2)	Stone, sand and gravel, petroleum.
Beaver	17, 936, 874	20, 738, 219	Natural gas, petroleum, natural gas liquids, pumice.
Beckham	12, 418, 698	8, 007, 395	Petroleum, natural gas liquids, natural gas.
Blaine	(2)	1, 996, 927	Gypsum, petroleum, natural gas, sand and gravel.
Bryan	2, 243, 494	2, 013, 459	Petroleum, natural gas, stone, sand and gravel.
Caddo	16, 530, 426	13, 943, 384	Petroleum, natural gas, stone, gypsum, sand and gravel.
Canadian	231, 793	293, 503	Natural gas, petroleum, sand and gravel.
Carter	65, 082, 096	61, 921, 000	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Cherokee	(2)	(2)	Stone, sand and gravel.
Choctaw	(2)	(2)	Stone, sand and gravel, petroleum.
Cimarron	7, 078, 005	7, 808, 287	Helium, natural gas, petroleum.
Cleveland	16, 065, 192	15, 716, 405	Petroleum, natural gas, natural gas liquids.
Coal	1, 804, 928	2, 044, 084	Petroleum, stone, natural gas.
Comanche	3, 010, 464	2, 550, 786	Stone, petroleum, natural gas.
Cotton	4, 758, 419	4, 970, 078	Petroleum, sand and gravel, natural gas.
Craig	338, 413	524, 280	Coal, petroleum, natural gas, stone.
Creek	31, 273, 162	32, 066, 778	Petroleum, natural gas liquids, natural gas, clays, stone.
Custer	1, 129, 578	609, 774	Stone, natural gas liquids, petroleum, clays, natural gas, gypsum.
Dewey	200, 272	470, 589	Petroleum, bentonite, natural gas.
Ellis	135, 373	293, 293	Natural gas, petroleum.
Garfield	6, 332, 851	5, 747, 457	Petroleum, natural gas, natural gas liquids, clays.
Garvin	85, 069, 779	77, 509, 549	Petroleum, natural gas liquids, natural gas, sand and gravel.
Grady	25, 696, 816	20, 866, 573	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Grant	5, 251, 137	5, 297, 352	Petroleum, natural gas, natural gas liquids.
Greer	342, 108	364, 465	Petroleum, stone, sand and gravel, natural gas, clays.
Harmon	(2)	13, 112	Salt.
Harper	11, 324, 428	11, 607, 580	Natural gas, natural gas liquids, petroleum.
Haskell	2, 818, 969	3, 085, 266	Coal, natural gas, stone.
Hughes	5, 659, 660	5, 575, 839	Petroleum, natural gas, stone.
Jackson	614, 691	592, 107	Petroleum, sand and gravel, natural gas.
Jefferson	4, 209, 055	3, 919, 973	Petroleum, natural gas.
Johnston	(2)	(2)	Sand and gravel, stone.
Kay	15, 442, 272	14, 222, 734	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Kingfisher	3, 276, 651	14, 575, 926	Petroleum, natural gas, sand and gravel, natural gas liquids.
Kiowa	1, 717, 357	1, 848, 534	Petroleum, stone, natural gas, sand and gravel.
Latimer	113, 964	195, 572	Natural gas, stone, sand and gravel.
LeFlore	1, 763, 997	1, 396, 302	Coal, natural gas, stone, sand and gravel.
Lincoln	22, 647, 299	26, 366, 611	Petroleum, natural gas, natural gas liquids, stone, clays.
Logan	8, 064, 430	7, 185, 993	Petroleum, natural gas, natural gas liquids, sand and gravel.
Love	2, 773, 248	6, 557, 458	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Major	3, 429, 053	4, 613, 510	Petroleum, natural gas, natural gas liquids, sand and gravel.
Marshall	7, 551, 831	6, 588, 879	Petroleum, natural gas liquids, natural gas, sand and gravel.
Mayes	(2)	(2)	Cement, stone, clays, petroleum.
McClain	26, 277, 047	26, 516, 799	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
McCurtain	175, 746	1, 021, 290	Petroleum, sand and gravel, gem stones.
McIntosh	(2)	799, 023	Stone, coal, natural gas, petroleum, sand and gravel.

See footnotes at end of table.

TABLE 23.—Value of minerals produced in Oklahoma, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value
Murray	$2,445,611	$2,149,867	Stone, petroleum, natural gas, sand and gravel.
Muskogee	1,320,667	2,673,289	Petroleum, sand and gravel, natural gas, coal.
Noble	8,834,732	9,463,518	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Nowata	7,551,928	6,095,731	Petroleum, stone, coal, natural gas.
Okfuskee	9,531,800	9,288,077	Petroleum, natural gas, natural gas liquids.
Oklahoma	23,112,786	23,046,920	Petroleum, natural gas liquids, natural gas, sand and gravel, clays.
Okmulgee	7,638,157	6,854,550	Petroleum, natural gas, coal.
Osage	75,013,318	73,412,799	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Ottawa	1,672,554	1,656,536	Zinc, stone, lead, tripoli, sand and gravel.
Pawnee	6,096,931	5,507,067	Petroleum, stone, sand and gravel, natural gas, natural gas liquids.
Payne	9,459,884	8,618,966	Petroleum, stone, natural gas, natural gas liquids.
Pittsburg	(2)	1,321,706	Stone, coal, natural gas, sand and gravel, clays.
Pontotoc	18,494,050	20,132,112	Cement, petroleum, stone, sand and gravel, natural gas, natural gas liquids, clays.
Pottawatomie	12,550,384	12,087,480	Petroleum, natural gas liquids, natural gas, stone.
Pushmataha	(2)	1,110,306	Petroleum, sand and gravel.
Roger Mills	7,500	------------	
Rogers	5,167,713	6,211,161	Petroleum, cement, coal, stone, clays, natural gas.
Seminole	28,461,458	28,332,714	Petroleum, natural gas liquids, natural gas, stone, clays.
Sequoyah	2,356,525	1,726,349	Lime, coal, stone, natural gas, sand and gravel, petroleum.
Stephens	67,940,210	68,644,324	Petroleum, natural gas, natural gas liquids.
Texas	24,431,562	22,490,093	Natural gas, petroleum, natural gas liquids, sand and gravel.
Tillman	2,302,938	2,053,698	Petroleum, sand and gravel, natural gas.
Tulsa	7,420,447	8,262,941	Petroleum, stone, sand and gravel, clays, natural gas.
Wagoner	1,658,589	737,561	Petroleum, natural gas.
Washington	22,097,101	20,029,693	Petroleum, cement, stone, clays, natural gas.
Washita	1,410,773	788,233	Natural gas, petroleum, gypsum.
Woods	772,360	690,119	Natural gas, petroleum, salt, sand and gravel.
Woodward	479,847	536,816	Natural gas, petroleum, sand and gravel.
Undistributed	8,532,916	16,406,775	
Total	[3] 780,942,000	785,973,000	

[1] Delaware County is not listed because no production was reported.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Beaver.—Natural gas liquids were recovered from natural gas by four processing plants. The Cabot Corp. planned construction of a gasoline plant capable of processing 30 million cubic feet of gas per day; completion was expected in September 1962. LaRue-Axtell Pumice Co. mined volcanic ash near Gate.

Beckham.—Petroleum and natural gas were produced, mostly from the Elk City field. Natural gas liquids were processed from natural gas by Shell Oil Co. at its Elk City cycling plant.

Blaine.—Gypsum was mined northeast of Watonga by Universal Atlas Cement Co. and west of Okeene by Walton Gypsum Co. United States Gypsum Co. quarried and crushed gypsum and operated a large calcining, sheetrock, and plaster plant at Southard. Sand and gravel was produced by Tindel Materials Co. Minor quantities of petroleum and natural gas were produced.

Bryan.—Petroleum and natural gas were produced from the Aylesworth, S.E. field. Limestone was quarried and crushed for highways for the State highway department. Two operators mined structural and paving sand from pits near Colbert; the State highway department obtained paving sand elsewhere in the county.

Caddo.—Petroleum and natural gas were produced from several fields; cement, the largest field, furnished more than 4 million barrels of oil. At Cyril, the 10,000-barrel-a-day refinery of Anderson-Prichard Oil Corp. operated throughout the year. Dimension and crushed limestone were produced. Gypsum for portland cement and agricultural uses was mined near Lindsay by Harrison Gypsum Co. Paving sand was produced for the State highway department.

Carter.—Carter County ranked fourth in total value of minerals and natural gas liquids and third in petroleum production. Petroleum and natural gas were produced from numerous fields; the Fox-Graham, Healdton, Hewitt, and Sho-Vel-Tum fields were the largest. The Sho-Vel-Tum field was the third largest producing field in the Nation. Natural gas liquids were recovered at six plants. The 12,000-barrel-a-day refinery of Ben Franklin Refining Co., at Ardmore, was remodeled by Bell Oil & Gas Co. Paving sand and crushed limestone were produced for the State highway department.

Cimarron.—The Federal Bureau of Mines recovered helium from natural gas at its Keyes helium extraction plant. Helium-bearing gas was supplied to the plant by Colorado Interstate Gas Co. Natural gas and petroleum were produced from several fields in the Keyes area.

Cleveland.—Natural gas liquids were recovered at plants of Continental Oil Co. and Sunray Mid-Continent Petroleum Corp.

Comanche.—Crushed limestone was produced by Dolese Bros. Co. at its Richards Spur Quarry north of Lawton. Petroleum and natural gas were produced from a group of small fields (comprising three districts) and the Fort Sill Reservation field.

Cotton.—Petroleum and natural gas were produced from a group of fields in the Walters and Cache Creek districts and from several other fields. Paving gravel was produced for the State highway department.

Craig.—Coal, strip-mined at five pits by four operators, increased in value from $320,291 in 1960 to $491,965. Minor quantities of petroleum and natural gas were produced. Limestone was quarried and crushed for use by the State highway department.

Creek.—Petroleum and natural gas were produced from numerous fields; the prolific Cushing and Glenn Pool furnished more than 5.9 million barrels of petroleum. Natural gas liquids were recovered at processing plants operated by Kerr-McGee Oil Industries, Inc.; Sinclair Oil & Gas Co., and Warren Petroleum Co. At Sapulpa, clay for manufacturing brick and tile was produced by Sapulpa Brick & Tile Co. and for pottery by Frankoma Pottery Co. Limestone was quarried and crushed by two producers.

Custer.—Clay for brick and tile manufacturing was produced by Acme Brick Co. Natural gas liquids were recovered at the Bartlett cycling plant of Keener Oil Co.

Garfield.—Natural gas liquids were recovered by Sinclair Oil & Gas Co. at Covington. The 32,000-barrel-a-day Enid refinery of Champlin Oil & Refining Co. operated throughout the year; about yearend the firm completed a delayed-coking unit at the refinery. Enid Brick & Tile Manufacturing Co. mined clay for brick manufacturing.

Garvin.—Garvin County remained first in total value of minerals and mineral fuels produced, however, it ranked fourth in petroleum production. Petroleum and natural gas were produced from numerous fields. About 18 million barrels of petroleum were produced. The O. H. Grimes, Lone Star Gas Co., Phillips Petroleum Co., Service Gas Products Co., Sohio Petroleum Co., and Warren Petroleum Co. plants recovered natural gas liquids. The 17,500-barrel-a-day refinery of Kerr-McGee Oil Industries, Inc., at Wynnewood operated throughout the year. Construction sand was mined by Lamar Lawson from deposits east of Pauls Valley; paving sand and gravel was produced by one operator for the State highway department.

Grady.—Natural gas liquids were recovered by two processing plants and two cycling plants. Sand for construction and paving was obtained from pits near Tuttle by The Dolese Co.

Grant.—Natural gas liquids were recovered by Continental Oil Co. at its new absorption and refrigeration-type natural gasoline plant near Medford. Capable of processing about 30 million cubic feet of gas per day, the plant recovered propane, butane, and natural gasoline.

Greer.—Petroleum and natural gas were produced from the Lake Creek district. Granite was quarried by Century Granite Co., Inc., near the town of Granite. Sand and gravel was produced by four operators. Clay was mined at the pit of Mangum Brick & Tile Co., south of Mangum.

Harper.—Gas from the big Laverne gasfield was processed at Sun Oil Co.'s gasoline plant, which recovered natural gas liquids.

Haskell.—Coal, produced at one underground mine and five open-pit operations by six operators, increased 13 percent in value. Haskell County remained the leading coal-producing county.

Hughes.—Petroleum and natural gas were produced from numerous fields. Limestone and sandstone were quarried and crushed for use by the State highway department.

Johnston.—Pennsylvania Glass Sand Corp. of Oklahoma produced sand for glass and ground silica from pits north of Mill Creek. Paving sand and gravel was produced for highways. Dimension limestone for building was produced near Pontotoc by Ada Stone Co.; crushed limestone for road construction was produced by Rock Products Corp. Taylor Granite Co. began operations at its Mill Creek quarry.

Kay.—Petroleum and natural gas were produced from numerous fields; natural gas liquids were recovered at plants of Cities Service Oil Co. and Wunderlich Development Co. Petroleum refineries of Cities Service Oil Co. and Continental Oil Co. at Ponca City operated throughout the year. Petrochemical units of the Continental Oil Co. refinery produced benzene, toluene, and propylene hydrocarbons and carbon black. A 300,000-barrel underground LP gas storage site in limestone was completed for Continental Oil Co. in April. Crushed limestone was produced by Cookson Stone Co. at its quarry and plant northeast of Ponca City. Sand was produced by Midwest Concrete Supply Co. for construction and paving and for the use of the State highway department. Blackwell Zinc Co., Inc., a division of American Metal Climax, Inc., operated a zinc smelter throughout the year.

Kingfisher.—Natural gas liquids were recovered at the Trindle plant of Sohio Petroleum Co. in the West Edmond field. Two new natural gas processing plants, being erected in the Dover-Hennessey field by Continental Oil Co. and Humble Oil & Refining Co., were scheduled to be completed in 1962. Pan American Petroleum Corp. planned to build a natural gas plant at the North Okarche field. Building and paving sand were produced from pits near Dover by The Dolese Co.

Kiowa.—Dimension granite was quarried near Snyder by three operators and near Hobart by Century Granite Co. Southwest Sand Co. produced building sand; Roosevelt Materials Co. produced crushed limestone for concrete aggregate.

LeFlore.—Coal was mined by seven operators, all at underground mines. The county ranked third in value of coal. Paving sand and gravel and crushed sandstone were produced for highway surfacing. Natural gas was produced, mainly from three fields.

Lincoln.—Petroleum and natural gas were produced from numerous fields. Natural gas liquids were recovered by five plants. Kerr-McGee Oil Industries, Inc., on December 1, closed its gas-liquids plant. The Allied Materials Corp. 3,500-barrel-a-day refinery at Stroud operated throughout the year. Stroud Clay Products Co. produced clay for building brick.

Logan.—Petroleum and natural gas were produced from numerous fields, and natural gas liquids were recovered at the cycling plant of Eason Oil Co. Building sand was produced by John McConnell.

Love.—Texaco, Inc., was building a 23-million-cubic-feet-per-day natural gas processing plant in Southwest Enville field near Marietta. Completion was scheduled for July 1962. Sand and gravel was produced by Gulf, Colorado and Santa Fe Railway Co. and for the State highway department.

Major.—Petroleum and natural gas were produced, mostly from Ringwood field. Natural gas liquids were recovered by Warren Petroleum Co. at its Ringwood plant. Construction sand was produced by Orin Law.

Marshall.—Petroleum and natural gas were produced from several fields; most important was Cumberland field, which yielded 1.2 million barrels of oil. Natural gas liquids were recovered at plants of Warren Petroleum Corp. and Service Gas Products Co. Near Madill, sulfur from sour gas was recovered by Central Chemical Co. Paving gravel was produced for use on highways by the State highway department.

Mayes.—Limestone and clay were produced for cement manufacture by Oklahoma Cement Co. at its plant southeast of Pryor. Crushed limestone was quarried for roadstone, concrete aggregate, and agstone by the State highway department and Cookson Stone Co. A small quantity of petroleum was produced.

McClain.—Petroleum and natural gas were produced at numerous small fields, and natural gasoline was produced at the Criner plant of Sunray Mid-Continent Oil Co. Sand for highway paving was produced.

McIntosh.—Value of coal output was considerably below that of 1960 as a result of the closing of one mine. Small quantities of natural gas and petroleum were produced, mostly from the Coalton and Stidham fields. Sand was produced for highways by the State highway department.

Murray.—Limestone was mined and crushed at the Rayford and Big Canyon quarries of The Dolese Co. and elsewhere by other producers. Building and paving sand and gravel were produced by Joe Brown Co. Petroleum and natural gas were produced from two fields. Production of asphaltic limestone and asphaltic sandstone was suspended after more than 70 years of continuous activity.

Muskogee.—Petroleum and a small quantity of natural gas were produced. Late in the year, Mid-Continent Pipeline Co. began constructing a 4-inch crude oil gathering system from its Bald Hill station into the reactivated Muskogee field. Structural, paving, and fill sand was dredged from the Arkansas River by Yahola Sand Co.; the State highway department dredged gravel. At Muskogee, Fansteel Metallurgical Corp. operated its columbium-tantalum plant. Callery Chemical Co. continued to produce high-energy fuels at its Muskogee plant. Corning Glass Works completed an addition to its Muskogee plant; this addition increased its glassmaking capacity 50 percent.

Noble.—Petroleum and natural gas were produced from numerous fields; natural gas liquids were recovered at the Lucien unit plant of Gasoline Plant Management Co. and by the Wunderlich Development Co. Limestone was quarried and crushed for use by the State highway department.

Nowata.—Petroleum and natural gas were produced from six fields. Crushed limestone was produced by Peerless Rock Co. Output of coal decreased appreciably in value due in part to the closing of one mine.

Okfuskee.—Petroleum and natural gas were produced from numerous fields. The productive Olympic field furnished more than 700,000 barrels of oil. Natural gas liquids were recovered at the Weleetka plant of Grimes & Grimes and at the Laffoon plant of Kerr-McGee Oil Industries, Inc.

Oklahoma.—Petroleum and natural gas were produced from numerous fields; the Oklahoma City field yielded more than 2.6 million barrels of oil. Natural gas liquids were recovered by Patton & Swab, Inc., Champlin Oil & Refining Co., Phillips Petroleum Co. (two plants), and Cities Service Oil Co. The Oklahoma City plant of Monarch Refineries, Inc., inactive through the first half of the year, was acquired by Trumbull Asphalt Co. on July 1. Building and paving sand was produced by three operators. Clay for manufacturing brick and tile was obtained from pits in the western part of Oklahoma City by Acme Brick Co. and United Brick & Tile Co. Near Choctaw, clay was mined and expanded for lightweight aggregate by Oklahoma Lightweight Aggregate Corp.

Okmulgee.—Petroleum and natural gas were produced from numerous fields. The Phillips Petroleum Co. refinery at Okmulgee continued to operate. Coal was mined underground near Henryetta by Consolidated Coal Co.

Osage.—Osage County, with many fields yielding oil and gas, was the State's leading oil-producing county. Under an extensive waterflooding program, the Burbank field produced 15.2 million barrels of oil and remained one of the most prolific fields. Natural gas liquids were recovered by Phillips Petroleum Co. (two plants). Crushed limestone was produced by Burbank Rock Co., Blake Stone Co., and Cookson Stone Co. Paving sand was produced for the State highway department.

Ottawa.—All of Oklahoma's lead and zinc output and a major part of the Tri-State district's output was supplied from mines in Ottawa County. In anticipation of a lead-zinc subsidy program, the tempo of mining operations increased despite depressed metal markets. The Rare Metals plant of The Eagle-Picher Co. was moved to new facilities at Quapaw. Chat, a product of zinc and lead milling, was supplied by six producers. Tripoli was quarried in east-central Ottawa County by American Tripoli Division of The Carborundum Co. and processed in its plant at Seneca, Mo. Sphalerite and galena mineral specimens were collected and sold as gem stones.

Pawnee.—Petroleum and natural gas were produced from numerous fields; natural gas liquids were recovered by Frame Natural Gasoline Co. Limestone was quarried and crushed by Cookson Stone Co. Construction and paving sand was produced by three operators.

Payne.—Petroleum and natural gas were produced from numerous fields; Yale-Quay, with a production of nearly 1 million barrels of oil, was the largest. Gas Products Corp. recovered natural gas liquids at its Norfolk field plant. The Cushing refineries of Kerr-McGee Oil Industries, Inc., and Midland Cooperatives, Inc., operated throughout the year. However, in October, the Kerr-McGee refinery ceased manufacturing gas and fuel oil and produced only high-quality lubricating oils, due to economic factors. Crushed limestone was produced by Cookson Stone Co. at its Cushing quarry.

Pittsburg.—Pittsburg County dropped to sixth place in value of coal produced because the underground coal mine of Lone Star Steel Co., closed in August 1960, was not reopened until July 1961. For a more efficient operation, new equipment was installed in the mine. Natural gas was produced from three fields near Quinton. Sand was produced for the State highway department and for the U.S. Army Corps of Engineers, Tulsa District. Clay for manufacturing brick and tile was produced by the Oklahoma State Penitentiary west of McAlester.

Pontotoc.—The Ada plant of Ideal Cement Co. operated throughout the year. Clay, shale, and limestone were quarried near Lawrence by Ideal Cement Co. for use in its plant. Dimension limestone was quarried near Fittstown by Townsend Quarry. Limestone was quarried and crushed by a new firm—H. Turner & Sons—at the Tibbetts quarry and Redland Ranch quarry for use as riprap. Mid-Continent Glass Sand Co. produced glass and molding sands. Building and paving sand was produced by The Dolese Co., Petroleum and natural gas were produced from many fields; natural gas liquids were recovered at the Fitts field gasoline plant of Humble Oil & Refining Co.

Pottawatomie.—Petroleum and natural gas were produced from numerous fields; the St. Louis field was the largest. Natural gas liquids were recovered at the St. Louis plant of Sinclair Oil & Gas Co.

Rogers.—Petroleum and natural gas were produced from three fields; Chelsea district produced most of the crude oil. Many wells in the

Oologah reservoir basin were plugged by the U.S. Army Corps of Engineers, Tulsa District, accounting for most of the decline in total wells in the State. The quantity of coal strip-mined by McNabb Coal Co. and Sinclair Coal Co. placed the county second among the State's coal producers. Dewey Portland Cement Division, American-Marietta Corp., put on stream in June its new $12 million, 1.25-million-barrel-per-year cement plant northeast of Tulsa; limestone and shale were quarried by the company for use in manufacturing cement. Shale was produced by Chandler Materials Co. as raw material for its lightweight aggregate plant. The U.S. Army Corps of Engineers, Tulsa District, continued work on the Oologah Dam on the Verdigris River. The Public Service Co. of Oklahoma completed its Northeastern Power Station, a 170,000-kilowatt steam-electric powerplant near Oologah Dam.

Seminole.—Petroleum and natural gas were produced from numerous fields; Seminole City field was the most prolific. Natural gas liquids were recovered at plants of Redco Corp., Sinclair Oil & Gas Co., and Phillips Petroleum Co. Limestone and sandstone were quarried and crushed for use by the State highway department. Clay for manufacturing brick and tile was obtained west of Wewoka by Wewoka Brick & Tile Co.

Sequoyah.—Limestone was mined and crushed north of Marble City at the St. Clair Lime Co. quarry. Part of the limestone was burned at Sallisaw in the company's kilns; the remainder was used for glassmaking, soil conditioning, and highway construction and maintenance. Gravel was produced for the State highway department. The total value of coal, mined from open pits by Sallisaw Stripping Co., was the fourth highest in the State. Natural gas was produced from a small field.

Stephens.—The county ranked second in petroleum production and sixth in natural gas output. Natural gas liquids were recovered at four plants. D–X Sunray Oil Co. operated its refinery at Duncan throughout the year.

Texas.—Texas County ranked first in value of natural gas produced from the vast Hugoton gasfield. Natural gas liquids were recovered near Guymon by Cities Service Oil Co. and Hugoton Plains Gas & Oil Co., and at other locations by Dorchester Corp., Excelsior Corp., Mobil Oil Co., and Panhandle Eastern Pipeline Co. Building and paving sand and gravel were produced by two operators.

Tillman.—Petroleum and a small quantity of natural gas were produced. The Grandfield refinery of Bell Oil & Gas Co. was converted to a terminal for asphalt and other products; crude oil formerly processed at Grandfield was routed to the Ben Franklin Refining Co. refinery at Ardmore. Building and paving sand and gravel were produced by two operators; gravel was produced by the State highway department. Century Granite Co. operated a granite-finishing plant at Frederick.

Tulsa.—In West Tulsa, The Texas Co. and D–X Sunray refineries operated throughout the year. D–X Sunray completed an 85,000-barrel-a-day crude oil distillation unit and a $1 million petrochemical unit to produce benzene and toluene. Near Garnett, crushed limestone was produced by Anchor Stone and Material Co., Chandler Materials Co., and Standard Industries, Inc. (two quarries). Construction and paving sand were produced by nine operators and the U.S. Army Corps of Engineers, Tulsa District. Brick and tile were manufactured by Acme Brick Co. and United Brick & Tile Co., in Tulsa, and by United Brick & Tile Co., in Collinsville. The U.S. Army Corps of Engineers continued work on the Keystone Dam on the Arkansas River.

Washington.—Petroleum and natural gas were produced from five districts. Dewey Portland Cement Co. quarried limestone and clay near Dewey for manufacturing portland cement. The plant closed in October for an indefinite period; surpluses, seasonal construction slumps, and general business conditions were cited for the shutdown. Crushed limestone was produced east of Bartlesville by M. E. Stewart and Sons. The Bartlesville smelter of National Zinc Co. operated throughout the year; sulfuric acid, a byproduct from imported zinc ores, was produced in addition to zinc.

Washita.—Natural gas and petroleum were produced from several small fields and from part of the prolific Elk City field. Gypsum for soil conditioning was quarried near Colony by Agricultural Gypsum Co.

Woods.—Natural gas and petroleum were produced from several small fields. Ezra Blackmon recovered salt by solar evaporation from water basins adjacent to the Cimarron River, west of Freedom. Paving sand was produced near Waynoka by Waynoka Sand & Gravel Co.

The Mineral Industry of Oregon

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries.

By Frank B. Fulkerson,[1] William N. Hale,[2] and Richard W. Knostman[3]

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OREGON mineral production in 1961 was valued at $54.9 million. The reported gain of $400,000 over the 1960 total of $54.5 million resulted from inclusion for the first time in the State totals of the lime recycled at pulp mills. The 1961 value of this recycled lime was $3.5 million. Except for this change in statistical coverage, the State mineral production value would have declined $3 million owing to less construction.

The principal products were sand and gravel, stone, cement, and nickel. Sand and gravel and cement output declined in 1961, nickel production was about the same as in 1960, and stone production was greater. In addition, small quantities of gold, silver, copper, lead, mercury, and uranium were produced in Oregon. Gold production

TABLE 1.—Mineral production in Oregon[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays......thousand short tons..	318	$370	294	$357
Copper (recoverable content of ores, etc.)....short tons..	6	4	([2])	([2])
Gold (recoverable content of ores, etc.)....troy ounces..	835	29	1,054	37
Iron ore (pigment material)......long tons..	....	....	829	([2])
Lime......thousand short tons..	([2])	([2])	221	5,157
Mercury......76-pound flasks..	513	108	138	27
Nickel (content of ore and concentrate)......short tons..	13,115	5,246	12,860	([2])
Pumice......thousand short tons..	([2])	([2])	203	461
Sand and gravel......do....	17,673	16,170	12,299	13,680
Silver (recoverable content of ores, etc.)...troy ounces..	284	([3])	2,022	2
Stone......thousand short tons..	[4] 16,913	[4] 19,721	17,272	20,939
Uranium ore......short tons..	([2])	([2])	2,160	66
Zinc (recoverable content of ores, etc.)......do....	....	....	3	1
Value of items that cannot be disclosed: Asbestos, carbon dioxide (1960), cement, diatomite, gem stones, lead (1961), and values indicated by footnote 2......	....	14,124	....	15,557
Total [5]......	....	[4] 54,520	....	54,922

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Less than $500.
[4] Revised figure.
[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime

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TABLE 2.—Indicators of Oregon business activity

	1960	1961[1]	Change, percent
Personal income:			
Total .... millions..	$4,005.0	$4,101.0	+2
Per capita	$2,259.0	$2,280.0	+1
Construction activity:			
Building permits .... millions..	$196.3	$185.2	−6
Heavy engineering awards .... do....	$216.7	$106.8	−51
Value of highway contracts awarded .... do....	$62.8	$53.3	−14
Cement shipments to and within Oregon..thousand 376-pound barrels..	3,096.8	2,954.4	−5
Cash receipts from farm marketings .... millions..	$415.5	$392.9	−5
Factory payrolls .... do....	$770.6	$763.2	−1
Annual average labor force and employment:			
Total labor force .... thousands..	719.5	723.2	+1
Unemployment .... do....	36.5	45.5	+25
Employment:			
Construction .... do....	26.1	23.7	−9
Lumber and wood products .... do....	71.9	66.9	−7
Food products .... do....	21.1	20.8	−1
All manufacturing .... do....	144.4	138.6	−4
All industries .... do....	682.3	677.2	−1

[1] Preliminary figures.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Oregon Business Review, Grow With Oregon, Oregon's Labor Market, Oregon Covered Employment and Payrolls, and Bureau of Mines.

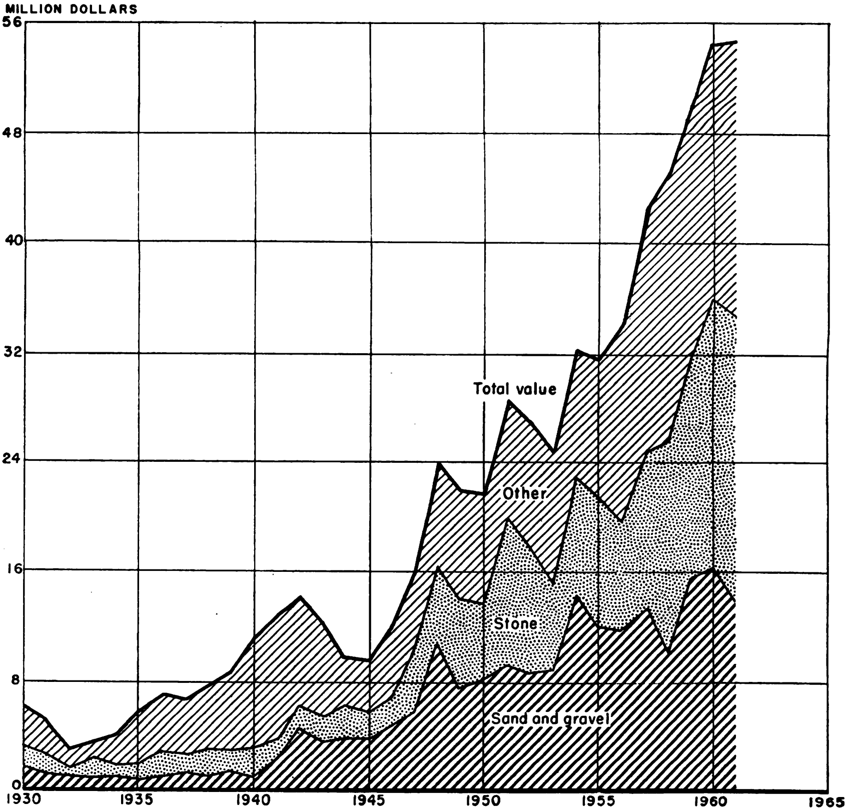

FIGURE 1.—Value of sand and gravel, stone, and total value of mineral production in Oregon, 1930–61.

TABLE 3.—Employment and payrolls in mineral-industry establishments subject to Oregon unemployment-compensation law, by industries

Industry	1960		1961	
	Employment	Payrolls (thousand)	Employment	Payrolls (thousand)
Mining	1,181	$6,662	1,112	$6,558
Stone, clay, and glass products:				
Glass and pottery	317	1,949	307	1,933
Hydraulic cement	451	2,893	425	2,724
Structural clay products	192	1,027	188	985
Concrete, gypsum, and plaster products	1,746	9,999	1,614	9,743
Cut-stone and stone products	49	300	44	251
Miscellaneous	105	572	96	580
Total	2,860	16,740	2,674	16,216
Primary metals:				
Blast furnaces, steelworks, rolling and finishing mills	1,344	9,819	1,390	10,225
Primary smelting and refining of nonferrous metals	1,944	12,666	1,802	11,957
Iron and steel foundries	1,952	11,772	1,826	11,535
Nonferrous foundries	240	1,287	311	1,730
Secondary smelting and refining of nonferrous metals and miscellaneous industries	271	1,584	203	1,215
Total	5,751	37,128	5,532	36,662
Industrial chemicals	477	2,970	485	3,274
Petroleum refining and related products	319	1,816	336	2,000
Grand total	10,588	65,316	10,139	64,710

Source: Oregon Employment Department. Industries may vary from those in the Bureau of Mines canvass.

TABLE 4.—Injury experience in the mineral industries[1]

Year and industry	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:						
Quarries and mills [2] [3]	833	214	1,428,386	----------	70	49
Nonmetal mines and mills [3]	186	213	315,624	----------	6	19
Sand and gravel operations [3]	837	191	1,264,783	2	25	21
Metal mines and mills [3]	190	159	242,138	----------	8	33
Coal mines	5	29	1,145	----------	----------	----------
Total	2,051	198	3,252,076	2	109	34
1961: [4]						
Quarries and mills [2] [3]	748	224	1,343,669	----------	51	38
Nonmetal mines and mills [3]	207	175	288,456	----------	9	31
Sand and gravel operations [3]	747	203	1,214,868	1	25	21
Metal mines and mills [3]	194	193	299,438	1	14	50
Coal mines	8	34	2,159	----------	1	463
Total	1,904	207	3,148,590	2	100	32

[1] Includes only commercial operations.
[2] Includes cement- and lime-processing plants.
[3] Includes officeworkers.
[4] Preliminary figures.

increased from 835 ounces to 1,054 ounces, and silver production increased from 284 ounces to 2,022 ounces.

The mineral production index was 103, compared with 110 in 1960 (1959=100). The index was the weighted average of the percentage gains and losses in the quantities produced, using 1961 values as weights. The sand and gravel tonnage declined 30 percent from 1960.

Owing to slow business conditions, there was little change in the mineral industries during 1961. The main new development was the beginning of oil exploration off the Oregon coast after the State passed an offshore lease law in May. Under the new law, four large oil companies obtained offshore exploration permits and began seismic investigations. The Willamette Valley, inland, also was the site of considerable leasing activity. In all, 13 major companies and 1 independent company were exploring for oil in the State.

Consumption, Trade, and Markets.—In the construction industry, activity decreased partly because of economic recession and partly because of a labor-management dispute, which tied up heavy construction in July and August. Construction furnished much of the market for Oregon's mineral industry production. All of the annual statistics for the State construction industry declined, including building permits, heavy engineering awards, value of highway contracts awarded, cement shipments, and construction employment.

Factory payrolls decreased $7 million (1 percent). Average monthly employment in manufacturing dropped 4 percent, due mostly to further cutbacks in lumber and wood products. Unemployment averaged 6.3 percent of the labor force in 1961, compared with 5.1 percent in 1960. Personal income per capita gained 1 percent, compared with 3 percent in 1960.

Employment and Injuries.—According to figures of the Oregon Employment Department, employment in the mineral industries decreased 4 percent because of fewer workers in mining, stone and clay products, and primary metals. All stone, clay, and glass products industries (principally glass and pottery, hydraulic cement, and concrete, gypsum, and plaster products) recorded decreases in employment. In primary metals, which was one of the fastest growing industries in Oregon in the 1950's, the employment decline was the first since 1954.

Table 4 gives data on injuries in the mineral industries, as compiled from reports by the companies to the Bureau of Mines.

Government Programs.—Under the program of the Office of Minerals Exploration (OME), U.S. Department of the Interior, contracts were active on mercury (A. O. Bartell, Clackamas County) and lead-zinc-copper (Emerald Empire Mining Co., Lane County). The contracts were for $14,920 and $54,300, respectively; Government participation was 50 percent.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—Coast Asbestos Co., John Day, Grant County, shipped a small quantity of chrysotile asbestos (long and short fiber) to Western Chemical & Manufacturing Co. in California for processing.

Cement.—Production of cement was about 10 percent less and shipments were 19 percent less than in 1960. Output was from plants of Oregon Portland Cement Co. at Oswego (Clackamas County) and at Lime (Baker County) and from Ideal Cement Co. at Gold Hill (Jackson County). Shipment destinations were chiefly within the State; out-of-State shipments were made to Washington, Idaho, and northern California.

Shipments of portland cement were distributed to ready-mixed concrete companies—57 percent; to general contractors—15 percent; to concrete-product manufacturers—12 percent; to building-material dealers—9 percent; to highway contractors—6 percent; and to Federal, State, and local government agencies—less than 1 percent. Portland cement was shipped from plants by truck, 80 percent; by boat, 13 percent; and by rail, 7 percent. The ratio of bulk to paper bag shipments was about 5:1.

Nine cement plants in Oregon and Washington produced 7,412,700 barrels (376 pounds each) of finished portland cement; shipments from the same plants totaled 7,385,700 barrels. The average value of portland cement shipped by Oregon and Washington producers remained at $3.52 per barrel, f.o.b. plant.

Clays.—Clays sold or used by producers declined 8 percent below 1960 because of decreased production of shale for use in manufacturing expanded lightweight aggregate and because of less clay used in making cement. Miscellaneous clay for making heavy clay products, principally agricultural draintile and building brick, increased 28 percent over 1960. A total of 16 companies in Benton, Clackamas, Klamath, Marion, Multnomah, Polk, Tillamook, Union, Washington, and Yamhill Counties provided clay for this use.

Shale was expanded at plants of Smithwick Concrete Products Co. and of Northwest Aggregate, Inc., in Washington County. The product was marketed mainly for use in manufacturing building brick; smaller quantities were used as lightweight-concrete aggregate and as pozzolan in constructing the John Day dam.

Clay and shale used at cement plants were produced in Baker and Jackson Counties.

Central Oregon Bentonite Co. produced 1,309 short tons of bentonite valued at $15,700 (f.o.b. mine) from a deposit in Crook County. Fifty percent of the bentonite output was marketed for use as a binder in making stock-feed pellets; about 47 percent was sold for use as a sealer in irrigation ditches and reservoirs; less than 3 percent was sold and used for pitch control in paper mills, for oil-well drilling mud, and as a filler in insecticides and fungicides.

Diatomite.—Production and shipments of prepared diatomite declined 23 percent, and value was 29 percent lower than 1960. Output was from operations of Great Lakes Carbon Corp., Mining & Mineral Products Division, near Terrebonne, Deschutes County. The company ceased mining operations at Terrebonne in August, and the diatomite processing plant was shut down in October. Prepared diatomite was marketed for use in filters, fillers, and insulation.

Lime.—Production totaled 80,400 short tons of quicklime and 2,000 short tons of hydrated lime valued at $1,702,000.

Chemical Lime Co., Baker, produced and sold 39,400 tons of quicklime for industrial use in making calcium carbide and cyanamide, in pulp manufacture, and at aluminum and steel plants. Hydrated lime production, totaling 2,000 tons, was sold for use in paper manufacturing, sugar refining, and water purification. Pacific Carbide & Alloys Co., Portland, produced 16,300 tons of quicklime for use in making calcium carbide; Amalgamated Sugar Co., Nyssa, made 24,700 tons of quicklime for use in sugar refining. Lime, recycled at paper mills, was included in the value for State mineral production for the first time. Four pulp manufacturing plants accounted for 139,000 tons of recycled quicklime, valued at $3,455,000. About 2 to 5 percent of the recycled production was original quicklime ("make up" lime). Limestone calcined to quicklime in paper company kilns is considered negligible; most of the quicklime used as "make up" lime is purchased from lime-producing companies.

Perlite.—Supreme Perlite Co., Portland, expanded crude perlite shipped from Nevada. The expanded product was used chiefly as a building plaster aggregate; small quantities were sold for soil conditioning and for concrete aggregate. Perlite occurrences in Klamath and Lake Counties were the subject of a report.[4]

Pumice and Volcanic Cinder.—Output of pumiceous materials (volcanic cinder and scoria) for use in highway construction increased sharply. Two operators in Deschutes County (Boise Cascade Pumice and Central Oregon Pumice Co.) produced pumice mainly for use in concrete aggregate; small quantities were shipped for use as an insulating medium. Three operators, Cinder Hill Co. (Deschutes County), and Babler Bros., Inc., and Earl McNutt Co., (both of Harney County), produced volcanic cinder and scoria for highway construction.

Sand and Gravel.—Total output of sand and gravel was 12.3 million tons valued at $13.7 million—declines of 30 and 15 percent, respectively, below the 1960 tonnage and value. The principal reason for the drop was curtailed use at projects of the U.S. Army Corps of Engineers—requirements were 5 million tons less than in 1960. The

TABLE 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	2,313	$2,706	2,634	$3,183
Road material	3,852	4,513	3.116	3.816
Other [1]	1,237	865	727	584
Total	7,402	8,083	6.477	7,583
Government-and-contractor operations:				
Building	3,734	2,583	126	106
Road material	4.582	4,757	5,695	5,990
Other [1]	1,954	747	([2])	([3])
Total	10,271	8,087	5,822	6,097
All operations:				
Building	6,047	5,289	2,760	3,289
Road material	8,434	9,270	8.811	9,806
Other [1]	3,191	1.612	727	584
Grand total [4]	17.673	16,170	12,299	13.680

[1] Includes fill material, special sands, railroad ballast, and sand and gravel used for miscellaneous purposes.
[2] Less than 500 short tons.
[3] Less than $500.
[4] Owing to rounding, the individual items may not add to totals shown.

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[4] Peterson, Norman V. Perlite Occurrences in Southeastern Klamath and Southwestern Lake Counties, Oregon. Oregon Dept. of Geol. and Min. Ind., The Ore-Bin, v. 23, No. 7, July 1961, pp. 65–70.

quantity of sand and gravel used by the State highway department was 3.5 million tons, compared with 2.9 million tons in 1960.

Commercial producers processed 6.5 million tons of sand and gravel valued at $7.6 million, compared with 7.4 million tons worth $8.1 million in 1960. Government-and-contractor production of 5.8 million tons was 4.5 million tons and $2 million less than 1960. Sand and gravel production was reported from 35 of the 36 counties. Multnomah and Lane Counties each produced over 2 million tons of sand and gravel; output exceeding 1 million tons was reported from Jackson County.

Stone.—Output of stone for all purposes reached a record 17.3 million tons valued at $20.9 million, a slight increase over the 1960 production of 16.9 million tons. The rise, despite a 1.5-million-ton decrease in State highway department utilization of crushed stone, resulted primarily from an increase of 3.5 million tons of crushed stone and riprap used at U.S. Army Corps of Engineers projects.

Commercial stone production was 3.7 million tons, and output of Government-and-contractor stone was 13.6 million tons, compared with 4.2 and 12.7 million tons, respectively, in 1960.

Basalt continued to be the principal stone quarried; output, 16 percent higher than in 1960, was used for roadstone, ballast, and riprap.

There was a 19-percent decrease in the quantity of limestone quarried—952,000 tons in 1961, compared with 1.2 million tons in 1960. Reduced demand for limestone used in cement manufacture and the closure of the Pacific Carbide & Alloys Co. Black Marble quarry in Wallowa County accounted for the decrease. The largest tonnage was consumed by the cement industry, followed by the lime, sugar, paper, and metallurgical industries, and agriculture. Limestone for industrial use was quarried in Baker, Jackson, Josephine, and Polk Counties.

Quartz, quartzite, and sandstone were produced and marketed by Bristol Silica Co., Jackson County; M & B Logging Co., Douglas County; and Crushed Rock Products Co., Washington County, for use in manufacturing ferrosilicon, refractories, abrasives, and cement.

Stone was produced from operations in all 36 counties; output exceeded 5 million tons in Lane County and 1 million tons in Baker County.

TABLE 6.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1960		1961	
	Quantity	Value	Quantity	Value
Building (dimension stone)	4	$37	3	$29
Concrete and roadstone	[1] 12,102	[1] 14,346	11,000	13,970
Riprap	2,879	2,886	4,717	4,910
Railroad ballast	309	328	(2)	(2)
Other [3]	[1] 1,619	[1] 2,125	1,552	2,030
Total [4]	[1] 16,913	[1] 19,721	17,272	20,939

[1] Revised figure.

[2] Included with "Other" to avoid disclosing individual company confidential data.

[3] Used at cement, paper, metallurgical, and chemical plants; sugar refineries; and for miscellaneous unspecified purposes.

[4] Owing to rounding, individual items may not add to total shown.

Talc and Soapstone.—Soapstone mined in Skagit County, Wash., was ground and prepared at plants of Miller Products Co. and Stauffer Chemical Co., Portland. Ground soapstone output, for use as a carrier in insecticides, increased 80 percent over 1960.

Vermiculite (Exfoliated).—Production and shipments of exfoliated vermiculite remained about the same as in 1960. Crude vermiculite from the Union of South Africa and Montana was exfoliated at Portland plants of Supreme Perlite Co. and Vermiculite Northwest, Inc., respectively. Expanded material was marketed as loose-fill insulation, as a lightweight aggregate for plaster and concrete, and for soil conditioning.

METALS

Aluminum.—Cerro Corp. purchased an option on 1,030 acres of riverfront land, with deep-water facilities, 42 miles from the mouth of the Columbia River at Wauna, and planned to build a $35 million primary aluminum reduction plant with an annual capacity of 55,000 tons. The company signed an agreement with Bonneville Power Administration (BPA) providing for 45,000 kilowatts of industrial power; an initial delivery date was scheduled for September 1, 1963.

Howe Sound Co. negotiated with the Port of Portland for a 230-acre plot, at the confluence of the Columbia and Willamette Rivers, on which to construct a $25 million reduction plant. Plans also included building an electrolytic manganese plant at the site.

Potential annual capacity at the Harvey Aluminum, Inc., reduction plant at The Dalles was expanded from 60,000 to 75,000 tons by the addition of 60 cells (pots) to the 240 already in operation. Other new items, including alloying and normalizing furnaces, a conveyor system, and continuous billet-casting equipment, were installed to permit a continuous uninterrupted flow of metal from the reduction state through the various processes.

Chromium.—Although no chromite was mined, interest continued in eastern and southwestern Oregon in finding markets for chromium ore and concentrate. The California-Oregon Chrome Producers Association applied to the Small Business Administration for a loan to construct a warehouse at Crescent City, Calif., in which ore and concentrate would be stockpiled until sold. The feasibility of deriving ferrochromium from Western metallurgical-grade chromite was the subject of a report.[5]

Copper.—Copper output increased slightly over 1960. Production from open-pit mining operations of Golden Road Mining Co., Jackson County, and Bolivar Copper Co., Coos County, accounted for most of the output. Both companies shipped crude ore to the Tacoma, Wash., smelter. Bolivar produced and shipped some concentrate from a 50-ton-a-day gravity mill, which was completed during the year. Smaller output was reported from Lane, Douglas, and Baker Counties.

Gold.—Gold production increased 219 ounces over 1960, but was the third lowest total in the history of the State. Twenty-seven placer operations yielded 67 percent of the output. Josephine County deposits accounted for nearly half of the total lode and placer produc-

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[5] Hunter, Willard L., and Gary A. Kingston. Ferrochromium From Western Metallurgical-Grade Chromite. BuMines Rept. of Inv. 5897, 1961, 9 pp.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
1952-56 (average)	15	22	2,178	4,993	$175	10,598	$10
1957	25	18	2,594	3,381	118	15,924	14
1958	17	33	1,947	1,423	50	2,728	2
1959	10	27	356	686	24	242	(3)
1960	13	34	1,231	835	29	284	(3)
1961	15	27	782	1,054	37	2,022	2
1852-1961	----------	----------	(4)	5,793,000	130,707	5,375,000	4,930

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952-56 (average)	5	$4	4	$1	1	(3)	$189
1957	23	14	5	1	----------	----------	148
1958	10	5	1	(3)	----------	----------	58
1959	----------	----------	----------	----------	----------	----------	24
1960	6	4	----------	----------	----------	----------	33
1961	(5)	(5)	(5)	(5)	3	1	44
1852-1961	12,481	4,713	826	100	176	24	140,474

[1] Includes recoverable metal content of gravel washed (placer operations), old tailings re-treated, ore milled and ore shipped to smelters during calendar year indicated. Owing to rounding, individual items may not add to total shown.

[2] Does not include gravel washed.

[3] Less than $500.

[4] Data not available.

[5] Figure withheld to avoid disclosing individual company confidential data.

TABLE 8.—Gold production at placer mines

Year	Mechanical and hydraulic methods			Small-scale hand methods [1]			Total		
	Number	Material treated (thousand cubic yards)	Gold (troy ounces)	Number	Material treated (thousand cubic yards)	Gold (troy ounces)	Number	Material treated (thousand cubic yards)	Gold (troy ounces)
1952-56 (average)	12	1,270	3,450	9	10	96	21	1,280	3,546
1957	10	34	126	8	7	53	18	41	179
1958	24	258	489	9	6	56	33	264	545
1959	19	54	396	8	4	54	27	58	450
1960	14	226	610	20	5	58	34	231	668
1961	[2] 10	[3] 104	570	17	17	135	27	121	705

[1] Includes surface and underground (drift) placers.

[2] Includes 5 dragline dredges, 4 hydraulic operations, and 1 plant reprocessing placer tailings.

[3] Does not include material washed at commercial gravel plants to produce byproduct gold and silver.

tion; the Greenback district, Josephine County, had the highest single mining district total, largely due to placer operations at the Davis and Joe Joe mines. Lode gold output was mostly from the Warner mine, Jackson County, and the Buffalo mine, Grant County.

Iron Ore (Pigment Material).—No iron ore was produced except limonite for use in pigment production. C. K. Williams & Co. mined iron oxide from the Scappoose deposit, Columbia County. The material

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc, in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold, gold-silver and dry silver[2]	12	625	343	1,722	(3)	(3)	----------
Copper, lead and lead-zinc[2]	4	157	6	196	(3)	(3)	6,000
Total lode	15	782	349	1,918	(3)	(3)	6,000
Gravel (placer operations)	27	(4)	705	104	----------	----------	----------
Grand total	42	782	1,054	2,022	(3)	(3)	6,000

[1] Because some mines produce more than one class of material, detail will not necessarily add to total shown.
[2] Combined to avoid disclosing individual company confidential data.
[3] Figure withheld to avoid disclosing individual company confidential data.
[4] 103,802 cubic yards of placer gravel washed.

was shipped to the company plant in Alameda County, Calif., for processing as mineral pigment. George Budock developed a small tonnage of iron ore on the Hanby property in the Sparta district, Baker County.

Lead.—Lead output, the highest since 1957, included the first significant production outside of Grant County since 1954. More than one-half the output was recovered from ore shipped by Emerald Empire Mining Co. from the Musick mine, Bohemia district, Lane County. Lead contained in gold-silver ore from the Buffalo mine, Grant County, accounted for most of the remainder.

Mercury.—Mercury production was 73 percent below the 513-flask output in 1960. This was the lowest State total since 1950 and the second lowest since 1926. The Arentz Mining Venture Bretz mine, Malheur County, accounted for 88 percent of the total output before ceasing operation in early March. The 122 flasks produced at the Bretz mine came from 2,848 tons of concentrate with a recoverable mercury content of 0.163 percent. Ten flasks were produced from ore mined and treated at the Red Rock claims, Harney County.

Nickel.—Hanna Mining Co. mined 863,107 tons of nickel silicate ore from its Douglas County open-pit operation near Riddle. Ore processed at the smelter yielded 40,482,860 pounds of ferronickel, containing 20,650,142 pounds of nickel. This was a decrease of 1,578,858 pounds of contained nickel from the 1960 record high. Following the April acquisition of the Hanna Nickel Smelting Co. Riddle plant from the Federal Government, Hanna began commercial marketing of ferronickel to eastern steel mills and foundries. A total of 125 million pounds of ferronickel will have been sold to the Government stockpile with the completion of contracts extending to June 30, 1965.

The Hanna nickel mining operation was the subject of a report.[6]

Silver.—Silver output was the highest since 1958. Lode deposits supplied 95 percent of the total; the largest output came from the Buffalo mine, Grant County. Silver was recovered from base metal ores of the Musick and other mines, Bohemia district, Lane County;

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[6] Bogert, John R. How Hanna Mines Lateritic Nickel Ore. Min. World, v. 12, No. 2, February 1961, pp. 27–29.

the Bolivar copper mine, Coos County; and the Chloride mine, Rock Creek district, Baker County.

Steel.—Ingots were produced and rolled into marketable shapes at Oregon Steel Mills, Inc.; production was from steel scrap remelted in electric furnaces.

Uranium.—Uranium production increased to 15,162 pounds of contained U_3O_8, all from Lake County. After pumping water out of the White King open-pit mine from March until June, Thornberg Mining Co. mined 1,881 tons of ore containing 13,000 pounds of U_3O_8. The remainder came from the Lucky Lass mine. All uranium ore was shipped to the Vitro Corp. mill in Salt Lake City, Utah.

In March, Kermac Nuclear Fuels Corp. purchased the Lakeview Mining Co. mill at Lakeview and planned to modify it to recover both uranium and vanadium oxides. The mill, which did not operate in 1961, was under contract to the Atomic Energy Commission (AEC) for the purchase of uranium oxides until November 1963.

Zinc.—Oregon zinc output, the highest since 1951, came from the Emerald Empire Mining Co. Musick mine, Bohemia district, Lane County. Three tons of zinc was contained in 38 tons of base-metal ore shipped to the United States Smelting, Refining and Mining Co. mill at Midvale, Utah.

Other Metals.—Sierra Metals Corp. began construction of a $750,000 metallurgical research laboratory near Portland to develop high-temperature materials and processes for use in space vehicles, jet engines, nuclear powerplants, and supersonic aircraft.

Wah Chang Corp., Albany, fabricated commercial quantities of superconductive columbium-zirconium alloys into wire of small diameter (.010 inch) and long length (over 1,000 feet) for the production of compact electromagnets.

Oregon Metallurgical Corp., also of Albany, successfully produced pure tungsten castings, by a centrifugal process, in hollow-ring shapes with up to 10-inch outside diameter. Production of titanium alloys for use in jet engines and missiles accounted for more than 50 percent of the company output. Other major products, including tungsten and zirconium ingots and high-purity vanadium for use in missiles and atomic energy work, helped to increase employment to more than 300.

Oregon Precision Industries, a new company established in Albany, fabricated titanium and other metal components for use in missiles, rocket engines, and nuclear power equipment.

MINERAL FUELS

Carbon Dioxide.—No production of natural carbon dioxide was reported in 1961. Gas-Ice Corp. abandoned the mineral water wells near Ashland.

Coal.—Pacific Power & Light Co. investigated potential coal deposits in the Squaw Basin area of southern Coos County. The company in past years had been evaluating the coal resources near Eden Ridge in southern Coos County to determine if adequate reserves of suitable quality coal were available to supply a proposed 100,000-kilowatt steam-electric powerplant.

Petroleum.[7]—No drilling permits were issued by the State Department of Geology and Mineral Industries in 1961. The only drilling was done by Humble Oil & Refining Co. on the "D. J. Leavitt No. 1", southeast of Lakeview; the test hole was completed in February at a depth of 9,579 feet.

Despite the small amount of drilling, the year proved to be one of the most active in oil exploration since enactment of the Oil and Gas Act in 1953, with 13 major companies and 1 independent company conducting geological and geophysical surveys.

In May, the Oregon Legislature passed an offshore lease law, which allowed oil exploration on tidelands and submerged lands owned by the State. The law determined that an exploration lease for offshore land be granted to the firm or individual offering the highest cash bonus, submitted by sealed bid. The size of each lease was to be not larger than 3 by 6 nautical miles (approximately 13,200 acres) and annual rental was established at 50 cents an acre. Four firms—Shell Oil Co., Gulf Oil Corp., Union Oil Company of California, and Standard Oil Company of California—were issued offshore exploration permits by the State in 1961. Seismic investigations constituted much of the exploration done by the companies.

In August, the Federal Government announced approval of an exploration lease that allowed firms engaged in offshore exploration to extend their surveys beyond the 3-mile limit along the Oregon and Washington coasts.

The Federal exploration permits did not include permission to drill exploratory holes, nor did they confer preference in obtaining oil and gas leases on these lands. Late in the year it was announced in the Northwest Oil Report that nine oil companies, participating jointly, had contracted for an aerial magnetic survey along the Oregon and Washington coasts. The participating companies were Standard Oil Company of California, Humble Oil & Refining Co., Mobil Oil Co., Ohio Oil Co., Pan American Petroleum Corp., Phillips Petroleum Corp., Richfield Oil Corp., Superior Oil Co., and Texaco, Inc.

In November, the Oregon Land Board approved a 12.5-percent royalty, plus bonus, bidding procedure as the basis for leasing State land for oil exploration. A 20,000-acre limit was established for onshore oil leases; land rental remained at 25 cents an acre, and drilling would be required within 2 years from the time the lease was taken. The board required a $10,000 bond on offshore oil leases at the time they are made, and this amount was to be increased to $50,000 when drilling began. Onshore bond requirements were established at $5,000 for each lease.

More than 100,000 acres was under lease for oil and gas in the Willamette Valley and adjacent areas by the end of 1961.

REVIEW BY COUNTIES

Mineral production was reported from all 36 counties in 1961. With certain important exceptions, output was principally from nonmetallic mineral deposits. Only those counties with significant metal and nonmetal production are discussed in the following review.

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[7] Oil-well drilling data were obtained from the Ore-Bin, a monthly publication of the Oregon Department of Geology and Mineral Industries.

TABLE 10.—Value of mineral production in Oregon, by counties

(Thousand dollars)

County	1960	1961	Minerals produced in 1961 in order of value
Baker	(1)	$4,927	Cement, stone, lime, clays, sand and gravel, gold, silver.
Benton	$384	251	Sand and gravel, stone, clays.
Clackamas	(1)	(1)	Cement, sand and gravel, stone, clays.
Clatsop	1,205	84	Stone, sand and gravel.
Columbia	389	(1)	Lime (recycled), stone, sand and gravel, iron ore (pigment material).
Coos	868	530	Stone, sand and gravel, copper, gold, silver.
Crook	340	425	Stone, sand and gravel, clays.
Curry	699	405	Sand and gravel, stone, gold.
Deschutes	1,260	870	Diatomite, pumice, stone, sand and gravel.
Douglas	7,212	7,001	Nickel, sand and gravel, stone, gold, mercury silver.
Gilliam	878	435	Stone, sand and gravel.
Grant	42	103	Stone, asbestos, gold, silver, sand and gravel, lead.
Harney	68	325	Stone, pumice, sand and gravel, mercury.
Hood River	151	535	Stone, sand and gravel.
Jackson	3,347	4,387	Sand and gravel, cement, stone, clays, gold, copper, silver.
Jefferson	430	(1)	Stone.
Josephine	231	753	Sand and gravel, stone, gold, silver.
Klamath	226	730	Stone, sand and gravel, clays.
Lake	320	343	Stone, uranium, sand and gravel, mercury.
Lane	7,844	8,275	Stone, sand and gravel, lime (recycled), zinc lead, gold, silver.
Lincoln	363	2,097	Lime (recycled), stone, sand and gravel.
Linn	457	1,488	Lime (recycled), stone, sand and gravel, gold, silver.
Malheur	457	735	Lime, sand and gravel, stone, mercury, gold, silver.
Marion	846	433	Sand and gravel, stone, clays.
Morrow	282	500	Sand and gravel, stone.
Multnomah	4,008	3,775	Sand and gravel, stone, lime, clays.
Polk	428	(1)	Sand and gravel, stone, clays.
Sherman	587	456	Stone, sand and gravel.
Tillamook	255	208	Sand and gravel, stone, clays.
Umatilla	1,171	608	Stone, sand and gravel.
Union	380	713	Stone, sand and gravel, clays.
Wallowa	270	188	Stone, sand and gravel, gold.
Wasco	426	236	Stone, sand and gravel.
Washington	1,016	1,045	Stone, clays, sand and gravel.
Wheeler	98	107	Stone, sand and gravel.
Yamhill	92	135	Do.
Undistributed [2]	18,743	13,181	
Total [3]	54,520	54,922	

(1) Figure withheld to avoid disclosing individual company data; included with "Undistributed."

[2] Includes value of mineral production that cannot be assigned to specific counties and values indicated by footnote 1.

[3] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime; 1960 total revised.

Baker.—Oregon Portland Cement Co. at Lime continued to supply the predominant value to the county mineral industry. The cement operation utilized limestone from the company Limerock quarry and shale from the company-owned Gales Creek quarry. Limestone for industrial and agricultural uses was mined also by Oregon Portland Cement Co. at a quarry near Durkee.

Chemical Lime Co. operated a lime manufacturing plant at Baker; Limestone, obtained from the company Marble Creek quarry northwest of Baker, was calcined and processed to quicklime and hydrated lime.

Sand and gravel output declined considerably because of a smaller quantity used by the State highway department.

Stone output declined 20 percent, owing to less limestone utilization by the cement and lime industries and less commercial and Government-and-contractor crushed stone production for use as road materials.

The Cornucopia gold mine was sold in December to a Pittsburgh, Pa., investment firm for $50,250. Assets included 1,000 acres of land, old mine buildings, and the abandoned townsight of Cornucopia. There had been no production from the mine since 1941. Three placer operations accounted for the second highest county placer gold output in the State. Rare Metals Corp. leased the Hulin quicksilver claims adjacent to Cave Creek in the Burnt River area. Some exploration was done on the property during the first part of the year.

Clackamas.—Oregon Portland Cement Co. continued cement production at Oswego; value was 3 percent less than in 1960. In terms of value, sand and gravel production was 36 percent less than in 1960. Stone production more than doubled because of use of basalt for road construction by the U.S. Forest Service. Three firms—Hubbard Clay Works, Molalla Brick & Tile Co., and Needy Brick & Tile Co.—mined clay for making heavy clay products; production remained at the 1960 rate.

Coos County.—Bolivar Copper Co. completed a new road from the millsite to the open-pit mine. The company contemplated replacing the 50-ton-a-day gravity mill, completed during the year, by one using a flotation process.

Crook.—Central Oregon Bentonite Co. mined bentonite at the Silver Wells mine southeast of Prineville.

Werdenhoff Mining Co. leased the Mother Lode property, in the Lookout Mountain area near Prineville, to Pacific Minerals & Chemical Co., Inc., Olympia, Wash.

Deschutes.—Great Lakes Carbon Corp. closed its diatomite mine near Terrebonne in August. According to the company, depleted reserves of crude diatomite suitable for manufacturing a filter grade product forced the closure of the operation. Processing of the mined material ceased at the Terrebonne plant in October.

Boise Cascade Pumice Corp. and Central Oregon Pumice Co., both of Bend, produced pumice for use in concrete aggregate. The Cinder Hill Co., Redmond, produced pumiceous material (volcanic cinder and scoria) for use in highway construction.

Douglas.—Commercial ferronickel, marketed by Hanna Mining Co. beginning in April, had a nickel content of 50 to 55 percent, compared with the 45 percent nickel and 55 percent iron product previously sold to the Federal stockpile. The use of a ferrosilicon alloy of increased silicon content was the principal metallurgical change in producing the higher nickel alloy.

Washington Mining Co. did some core drilling, drifting, crosscutting, and ore processing at the Elkhead mercury mine during the first part of the year. The small production was the first from this mine since 1957.

Mining-Minerals Manufacturing Co. processed slag from the Hanna Mining Co. electric furnace smelting operation in its plant at Riddle. An abrasive used as a sandblasting agent was marketed.

Grant.—Oregon Asbestos Co. revamped the asbestos mill at a property near Mt. Vernon, but no production was recorded.

A lower adit, started in 1960 at the Buffalo mine, Granite district, intersected the downward extension of the gold-silver bearing vein previously stoped on the upper levels. Development rock from the new level, 253 feet below the upper workings, accounted for the mine production. Work at the Standard mine, source of small quantities of copper in previous years, was suspended.

Jackson.—Ideal Cement Co. continued production of cement at Gold Hill; output was 18 percent less than in 1960. Limestone used at the plant was obtained from the company-owned Marble Mountain quarry in Josephine County, and shale was supplied from the company Gold Hill quarry.

Bristol Silica Co. mined quartz and quartzite at its silica quarry near Rogue River. The material was transported about 4 miles by truck to the crushing and screening plant at Gold Hill. A quantity of stone also was mined by the company and shipped for dimension stone.

P & K Chemical, Inc., mined limestone from the Seattle Bar quarry near Copper. The rock was hauled 22 miles by truck to a crushing and screening plant near Ruch; crushed stone was sold for roofing granules, poultry grit, and agricultural purposes.

Sand and gravel output increased fourfold over 1960 due to increased requirements for road construction by the State highway department. Production of stone declined 68 percent; less was used at projects of the U.S. Bureau of Reclamation.

Roy Houck & Sons Corp. recovered a gold-bearing concentrate as a byproduct of a gravel operation on Foots Creek while screening dredge tailings for use in highway construction. The gold was recovered from the concentrate at the Zinc Creek Mining Co. mill in Josephine County.

Josephine.—Value of mineral production was more than 3 times that of 1960, because more sand and gravel and stone were used for road construction at State highway department projects.

Ideal Cement Co. operated the Marble Mountain quarry to supply limestone for use at the company cement plant at Gold Hill, Jackson County. Limestone output was slightly less than in 1960.

Zinc Creek Mining Co. (Illinois Valley) produced a small quantity of byproduct gold from a gravel crushing operation. High Noon Corp. processed a quantity of tailings from the Esterly mine before leasing the mine to Journey's End Corp., but no record of concentrate sale by either corporation was recorded during the year.

Lane.—Output of 2 million tons of sand and gravel and 5.3 million tons of stone contributed significantly to the total value and ranked the county first in mineral production. Ten commercial firms produced 1.3 million tons of sand and gravel; the remainder was supplied by Government-and-contractor firms for use on Government road projects. Government-and-contractor stone production was 4.7 million tons; of this, 4.1 million tons was used by the U.S. Army Corps of Engineers in dam construction. Eight commercial stone producers supplied the remaining stone production from 15 quarries.

In May, Emerald Empire Mining Co. was granted an OME loan of $54,300 to explore for lead, zinc, and copper in the Bohemia mining district; Government participation was $27,150.

Linn.—The Bureau of Mines, Albany, began construction of an atomic research facility, which was to be completed by mid-1962. This new facility will house a 100,000-curie cobalt 60 source to be used to determine effects of gamma irradiation on the physical properties of coal, petroleum, and many metallic and nonmetallic minerals. Plans called for the irradiation chamber to have 4-foot-thick concrete walls and to contain a 17-foot well filled with deionized water in which the cobalt 60 source was to be stored when not in use.

Malheur.—Amalgamated Sugar Co., Nyssa, quarried limestone and calcined it to quicklime for use in sugar refining.

In the Bretz mercury mine area, Arentz Mining Venture completed 1,000 feet of rotary drilling in an attempt to develop new ore reserves. The Bretz mine ceased operation in March and remained closed the remainder of the year.

Multnomah.—Output of sand and gravel was 2.6 million tons, compared with 3.3 million tons in 1960; drop in Government-and-contractor production for use in road material accounted for the decrease.

Stone production increased 28 percent over 1960 because of more Government-and-contractor output used in road construction.

Columbia Brick Works mined clay from a company pit southeast of Gresham; the material was used in manufacturing building brick at the Portland plant.

Pacific Carbide & Alloys Co. calcined limestone purchased from the Ideal Cement Co., Texada Island, British Columbia, quarry for use in making calcium carbide. According to the alloy producer, it was cheaper to ship the limestone by barge from British Columbia than to ship limestone by rail from the company Black Marble quarry in Wallowa County.

Crude nonmetallic minerals produced in other States were shipped to processing plants in the county.

The Flintkote Co., Portland, produced natural- and artificial-colored roofing granules.

Calcium carbide, ferrosilicon, ferromanganese, silicomanganese, caustic soda, chlorine, and rolled and cast steel products were produced by chemical and metallurgical plants in Portland. Aluminum oxide from Japan was received at Portland for reduction to aluminum at the Harvey Aluminum, Inc., plant at The Dalles. Portland also was a port of entry for foreign base-metal ores and concentrates, transshipped to smelters in Idaho and Montana.

The export of steel scrap from the Port of Portland to Japan increased the price of steel scrap and reduced its availability to a local steel producer.

Polk.—Limestone was quarried near Dallas by Oregon Portland Cement Co. for use at the company cement plant near Oswego. Monmouth Brick & Tile Co. manufactured draintile from clay mined near Monmouth.

Wasco.—Harvey Aluminum, Inc., paid the largest amount of property taxes ever recorded in the county's history; this amount was based on an assessed valuation of $20 million. The Oregon State Tax Commission was seeking court aid in an effort to get the Wasco County assessor to place a $40 million valuation on the Harvey plant.

Washington.—Smithwick Concrete Products Co. and Northwest Aggregate, Inc., mined shale from quarries near Vernonia and Banks, respectively. In June, controlling interest in Smithwick Concrete Products Co. was purchased by Ore-Lite Industries, Inc. Included in the sale were the company headquarters at Portland, block manufacturing plants at Portland and Eugene, and the shale expanding plant near Vernonia. Ore-Lite Industries, Inc., preferred to retain the Smithwick company name.

Scholls Tile Co. mined clay, for use in making draintile, from a pit near Hillsboro at about the 1960 rate.

Frought & Co., Inc., a Portland steel fabricating firm, announced plans to build a $310,000 fabrication plant in the Tigard area. When completed, the new facility was to employ 60 men.

The Mineral Industry of Pennsylvania

By Robert D. Thomson,[1] Mary E. Otte,[2] and Robert E. Ela [3]

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PENNSYLVANIA'S mineral output in 1961 again was adversely affected by decreased markets. Output in 1961 was lower primarily because of decreases in the production of fuels and in the output of certain major nonmetallic industries. Anthracite, bituminous coal, clays, sand and gravel, and stone declined substantially in total value of output. The iron-ore, zinc, portland-cement, and lime industries were the only major mineral industries to show increases in 1961. Value of mineral production (fuels, metals, and nonmetals) totaled $792 million, a 4-percent decrease from 1960.

A new geologic map of Pennsylvania, which required 3 years to prepare, was issued by the State Topographic and Geological Survey during the year.

Employment and Injuries.—Employment in selected mineral industries as shown in table 2 was about 19 percent less than 1960. Safety was much improved, with 24 fewer fatalities and 445 fewer nonfatalities than in 1960.

The safety record of the bituminous coal industry continued to improve; the number of fatalities decreased from 28 to 22, and the number of nonfatal lost-time injuries decreased from 1,150 to 1,000. The number of fatalities per million man-hours was 0.57, compared with 0.60 in 1960. There were 0.35 fatalities per million short tons, compared with 0.43 in 1960. The number of nonfatal injuries per million man-hours was 26.13, compared with 24.77 in 1960. Of the fatalities, 20 occurred underground and 2 at strip mines. Falls of roof accounted for 11 of the underground fatalities. Of the remaining nine fatalities at underground mines, seven were from haulage, 1 from explosives, and one from mine fires. Both of the strip mine fatalities were caused by machinery.

The anthracite industry in 1961 reported 19 fatalities, compared with 35 in 1960. The number of nonfatal lost-time injuries decreased from 1,401 to 1,230. The number of injuries per million man-hours of exposure was 0.93 for fatalities and 60.12 for nonfatalities, compared with 1.43 and 57.30, respectively, for 1960. Of the 19 fatalities, 14 occurred underground, 3 at surface operations of underground mines, and 2 at stripping operations. Falls of roof caused nine of the under-

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TABLE 1.—Mineral production in Pennsylvania [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	36,374	$124,122	36,635	$124,506
Masonry—thousand 280-pound barrels	[2] 2,613	7,641	2,678	7,232
Clays [3]—thousand short tons	3,557	16,536	2,999	14,402
Coal:				
Anthracite—do	18,817	147,116	17,446	140,338
Bituminous—do	65,425	345,971	62,652	323,758
Gem stones	(4)	4	(4)	5
Lime—thousand short tons	1,120	16,277	1,124	16,896
Natural gas—million cubic feet	113,928	36,229	100,427	29,526
Natural gas liquids:				
Natural gasoline—thousand gallons	1,399	85	1,272	74
LP gases—do	1,580	138	1,453	115
Peat—short tons	30,837	325	27,993	291
Petroleum (crude)—thousand 42-gallon barrels	6,009	27,341	[5] 5,622	[5] 26,480
Sand and gravel—thousand short tons	13,011	21,204	12,594	19,766
Stone—do	42,136	74,168	41,834	71,344
Zinc [6] (recoverable content of ores, etc.)—short tons	13,746	3,559	23,428	5,408
Value of items that cannot be disclosed: Cobalt, copper, gold, graphite, iron ore, mica, pyrites, sericite schist, silver, soapstone (1960), and tripoli	----------	17,429	----------	25,355
Total Pennsylvania [7]	----------	[2] 823,360	----------	791,648

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Revised figure.

[3] Excludes kaolin; included with "Value of items that cannot be disclosed."

[4] Weight not recorded.

[5] Preliminary figure.

[6] Recoverable zinc valued at the yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

[7] Total adjusted to eliminate duplicating value of clays and stone in manufacturing lime and cement.

ground fatalities. Of the remaining eight fatalities at underground mines and associated surface operations, five were caused by haulage and one each by explosives, electricity, and machinery.

Three mines in Pennsylvania received top honors in the 37th National Safety Competition. National Gypsum Co.'s Bellefonte mine was the trophy winner for underground nonmetallic mines. The mine operated 239,336 man-hours without a disabling injury. The mine previously was awarded the trophy in 1949 and 1957 and received honorable mention in 1958 and 1959. The Newkirk Tunnel mine operated by Newkirk Mining Co. at Tamaqua, Schuylkill County, was the winner of the underground anthracite mine competition. The mine operated 55,181 man-hours during 1961 with only 3 temporary disabling injuries, each everaging 11 days of lost time. The Maple Creek mine in Washington County was operated by United States Steel Corp. without a disabling injury and received the top award for underground bituminous coal mines. This was the first top award for this mine in its third successive year of competition. It won fourth place in the group in 1960.

Legislation and Government Programs.—Pennsylvania enacted new legislation on strip mining of bituminous coal and anthracite to become effective January 1, 1962. The bond requirement for bituminous strip mines was increased from $300 to $400 per acre, and the minimum total requirement, from $3,000 to $4,000. For anthracite mines the bond was raised from $300 to $500 per acre, and the minimum total, from $3,000 to $5,000. Further protection for homes, highways, and public buildings was provided by strengthening the backfilling requirements of abandoned mines.

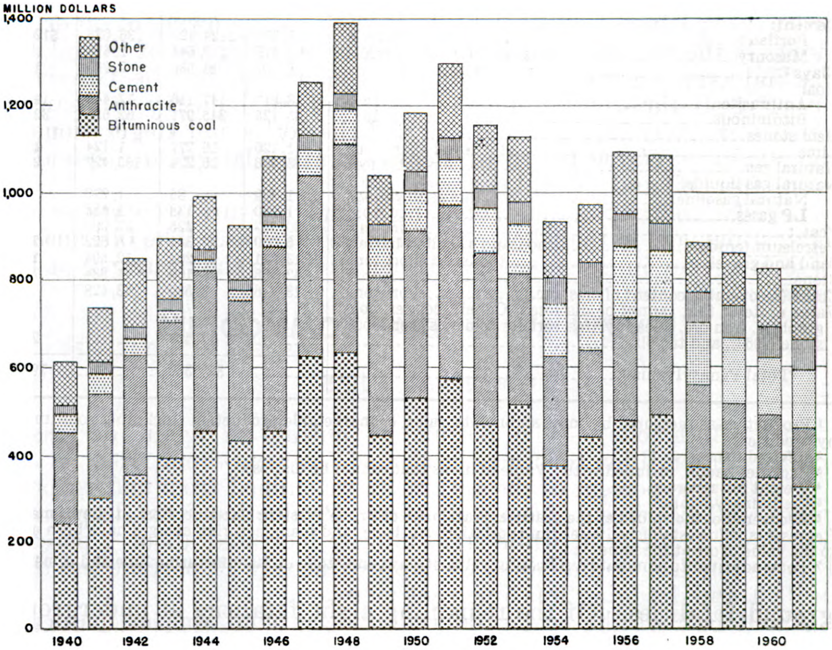

FIGURE 1.—Value of bituminous coal, anthracite, cement, and stone, and total value of mineral production in Pennsylvania, 1940–61.

TABLE 2.—Employment and injuries for selected mineral industries

Industry	1960		1961 [1]				
	Average number of men working	Total man-hours	Average number of men working	Total man-hours	Total number of lost-time injuries		Number of injuries per million man-hours
					Fatal	Nonfatal	
Anthracite	19,051	24,452,382	15,792	20,460,000	19	1,230	61.05
Bituminous coal	28,100	46,430,000	22,300	38,270,000	22	1,000	26.70
Cement [2]	3,581	8,131,699	3,146	7,112,423	--------	20	2.81
Clays	642	976,581	474	720,755	--------	28	38.85
Lime [2]	992	2,073,990	847	1,855,370	--------	43	23.18
Sand and gravel	1,480	2,777,317	1,383	2,465,060	--------	33	13.39
Stone [3] [4]	3,374	6,486,512	2,956	5,695,796	1	175	30.90

[1] Preliminary figures.

[2] Includes quarries or pits producing raw materials used in manufacturing cement or lime for captive operations.

[3] Includes quarry or open-pit employees as well as crushing and screening and rock dressing operations.

[4] Excludes quarries or pits producing limestone from captive operations used in manufacturing cement or lime.

A proposed bill for transportation of coal by pipelines in Pennsylvania was passed in the house but defeated in the Senate State Government Committee. The bill cannot be reintroduced until the general session of the legislature in 1963.

Pennsylvania's first oil and gas conservation legislation was enacted during the year. The act created an Oil and Gas Commission in the State Department of Mines and Mineral Industries with authority to order the spacing of wells on application from any owner of oil or gas rights in the territory considered. Six representatives of the oil and gas industry were appointed to the commission by the Governor. Other regulations pertaining to the oil and gas industry in Pennsylvania were Acts 225, 322, and 352 and the Rules and Regulations of the Sanitary Water Board of Pennsylvania relating to disposal of waste from oil and natural gas wells.

Legislation was passed establishing a fund to insure property owners against damage to their homes from mine cave-ins. The bill authorized an agency in the mines department to write the insurance at low rates.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Anthracite).—The output of anthracite again decreased, totaling 17.4 million tons, a reduction of 7 percent from 1960.

Thirty-nine percent of the anthracite was mined from underground mines, and 42 percent, from strip pits. Production from deep mines was down 12 percent, while strip mining increased about 2 percent. Production from culm banks was approximately 19 percent less than in 1960, and dredging was 5 percent more.

About half of the coal produced underground was mechanically loaded—3.4 million tons, compared with 4 million tons in 1960. Hand-loaded coal totaled 3.4 million tons, compared with 3.7 million tons in 1960. A total of 132 scraper loaders, 18 more than in 1960; 27 mobile loaders, 18 less than in 1960; and 616 conveyors and pit-car loaders, 138 less than in 1960, were used to mechanically load coal mined underground.

Production from culm banks totaled 2.7 million tons, compared with 3.3 million tons in 1960. Operations were active in Lehigh, Schuylkill, Wyoming, and Sullivan Counties. The largest output, 1.4 million tons, came from the Schuylkill region.

The Lehigh, Schuylkill, and Susquehanna Rivers and their tributaries were dredged for anthracite. Production by dredges totaled 746,000 tons valued at $2.4 million. Of the total production, 620,000 tons came from the Susquehanna River, 123,000 tons from the Schuylkill River, and 3,000 tons from the Lehigh River.

Shipments of anthracite totaled 17.4 million tons. Of this total 9 million tons was shipped by truck, and 8.4, by rail. Wholesale price indexes (1947–49 equals 100) f.o.b. mines were 117.2 for chestnut, 115.1 for pea, 149.9 for buckwheat No. 1, and 195.8 for buckwheat No. 3.

Output per man per day for all types of operations was 5.63 tons, compared with 5.60 in 1960. The average weekly earning was $96.03, the average hourly earning was $2.73; and the average number of hours worked per week was 35.1.

Schuylkill County continued to be the principal center for producing anthracite—6.9 million tons in 1961. Luzerne County ranked second with production of 5.6 million tons, followed by Northumberland and Lackawanna Counties. Other counties producing anthracite were Berks, Carbon, Columbia, Dauphin, Lancaster, Lebanon, Northampton, Snyder, Sullivan, Susquehanna and Wayne.

Coal (Bituminous).—Output from the Pennsylvania bituminous coal fields decreased. Production from underground mines decreased 6 percent; that from auger mines, 3 percent; and that from strip mines, less than 1 percent. A total of 1,220 mines producing 1,000 tons or more each was active during the year. The number of underground mines and strip mines reporting production decreased by 45 and 18, respectively. One more auger mine was active in 1961 than in 1960. Approximately 66 percent of the bituminous coal output came from underground mines. A total of 40.7 million tons of the 41.4 million tons produced underground was cut by machines, including continuous miners; the remainder was cut by hand or shot from the solid. In all, 840 cutting machines and 353 continuous miners were used, compared with 1,032 and 337, respectively, in 1960.

TABLE 3.—Bituminous coal production, by types of mining and counties in 1961

(Exclusive of mines producing less than 1,000 tons annually)

County	Underground		Strip		Auger	
	Number of mines	Short tons	Number of mines	Short tons	Number of mines	Short tons
Allegheny	21	4,269,411	23	483,848	------	------
Armstrong	45	1,489,466	46	1,418,745	11	102,047
Beaver	(1)	(1)	13	427,478	(1)	(1)
Bedford	(1)	(1)	(1)	(1)	------	------
Blair	2	5,599	1	45,217	------	------
Bradford	------	------	(1)	(1)	------	------
Butler	22	252,667	41	1,779,966	6	42,947
Cambria	87	5,587,343	21	436,379	1	2,415
Cameron	------	------	1	58,170	------	------
Centre	13	43,464	14	768,570	------	------
Clarion	8	37,487	30	2,940,570	1	5,370
Clearfield	72	1,218,933	101	5,298,289	11	121,954
Clinton	3	6,397	5	400,704	------	------
Elk	15	87,817	8	247,819	1	9,600
Fayette	(1)	(1)	21	321,819	(1)	(1)
Greene	18	9,522,117	4	25,997	------	------
Huntingdon	4	13,350	5	22,015	------	------
Indiana	72	4,058,955	29	561,345	4	24,592
Jefferson	32	283,444	29	977,957	5	43,039
Lawrence	1	7,600	17	590,018	3	34,156
Lycoming	2	6,010	3	52,351	------	------
McKean	------	------	(1)	(1)	------	------
Mercer	2	13,435	11	914,967	------	------
Somerset	100	1,034,487	47	1,061,278	------	------
Tioga	2	19,974	6	265,009	------	------
Venango	1	1,137	(1)	(1)	------	------
Washington	21	9,370,712	24	930,945	3	43,759
Westmoreland	43	3,133,133	25	175,768	(1)	(1)
Undistributed	49	979,709	10	539,624	4	34,721
Total	635	41,442,647	535	20,744,848	50	464,600

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

A total of 1,857 locomotives (2,046 in 1960), 294 conveyors (338 in 1960), 966 shuttle cars (1,013 in 1960), 19 rubber-tired tractors, 40 rubber-tired mine cars, 36,900 rail mine cars, and 19 shuttle buggies were used for underground haulage. Pennsylvania underground production continued to be highly mechanized, with 12.9 million tons cut using 840 cutting machines, 3 millions tons cut by 40 continuous mining machines and loaded directly onto conveyors, and 24.9 million tons cut by 313 continuous mining machines loading directly into shuttle cars. Mobile loaders were the principal moving device, loading 917,000 tons into mine cars, 455,000 tons onto conveyors, and 9,100,000 tons into shuttle cars. Handheld and post-mounted drills totaled 712 and drilled 8.2 million tons of coal; 66 mobile drills were used to drill 4.3 million tons of coal. In addition, 286 rotary and 417 percussion roof bolting drills and 171 other types of rock drills were used.

Production from strip mines decreased 131,000 tons, compared with 1960. Bituminous coal was stripped and loaded using electrical, diesel-electric, diesel, and gasoline power shovels and draglines. Of the 941 power shovels in use (5 more than in 1960), 867 had a dipper capacity of less than 3 cubic yards; 69, 3 to 5 cubic yards; 3, 6 to 12 cubic yards; and 2, more than 12 cubic yards. A total of 376 draglines was used (14 more than in 1960); 113 had a dipper capacity of less than 3 cubic yards; 163, 3 to 5 cubic yards; 89, 6 to 12 cubic yards; and 11, more than 12 cubic yards. Thirteen carryall scrapers were used; 1 had a capacity of less than 3 cubic yards; 1, 3 to 5 cubic yards; 8, 6 to 12 cubic yards; and 3, over 12 cubic yards. In addition, 794 bulldozers, 117 horizontal power drills, and 120 vertical power drills were used. The average distance from the pit to tipple was 6 miles. A total of 1,522 trucks or tractor-trailers were used at the stripping operations, having an average capacity of 13 tons per unit.

Rail tracks in the underground mines on main lines totaled 1,390.2 miles and 329.3 on all others.

The number of auger mines totaled 50, at which a total of 55 augers was used.

Bituminous coal produced from underground mines was shipped chiefly by rail or water (36.1 million short tons) and by truck (3.7 million short tons). Underground coal sold on the open market totaled 17.8 million tons and had an average value per ton of $5.17 ($5.34 in 1960). The average value of captive coal mined underground was $6.58 per ton. Shipments of strip coal by truck totaled 7.6 million tons, and shipments by rail or water totaled 13 million tons. Strip-mined coal had an average value of $3.60 per ton.

Of the auger mine production, 196,000 short tons was shipped by rail or water and 252,000 by truck. The value per ton of auger-mine coal sold on the open market averaged $3.12; average per ton for all coal from auger mines was $3.15.

Eighty-one preparation plants were active, 3 less than in 1960. A total of 37.7 million tons of coal was cleaned, compared with 39.6 million in 1960. Of the total, 33.8 million tons came from underground mines, 3.9, from strip mines, and the remainder, from auger mines. Of the raw coal mechanically cleaned, 42 million tons was wet washed, producing 6.8 million short tons of cleaned coal, using jigs, and 25.5 million tons, using other wet washing methods. A total of 6.1 million short tons of raw coal was cleaned using pneumatic methods, producing 5.4 million tons of cleaned coal.

A total of 27.5 million tons of coal was crushed; this represented 65 percent of the total production at mines having crushing facilities. Of the total production at these mines, 5.9 million tons was treated—1 million tons, with calcium chloride; 3 million tons with oil; 1.1 million tons, with both calcium chloride and oil; and 756,000 tons, with other materials.

Underground mines were worked in 25 counties, strip mines, in 28 counties, and auger mines, in 13 counties. Greene County continued to be the leading producer from underground mines; other leading counties in order of decreasing tonnage produced were Washington, Cambria, Allegheny, Indiana, Westmoreland, Armstrong, Clearfield, and Somerset. Clearfield County continued as the leading producing county from strip mines, followed by Clarion, Butler, Armstrong, and Somerset. Clearfield County replaced Armstrong County as the leading producer from auger mines.

Coke and Coal Chemicals.—Production from oven-coke operations decreased 6 percent, and from beehive coke ovens, 34 percent, compared with 1960.

Twelve plants, two less than in 1960, produced 13.3 million tons of oven coke, using 3,720 slot-type ovens to carbonize 19 million short tons of coal. Yield of coke from coal was 69.94 percent, compared with 69.27 percent in 1960. The average value of oven coke at the ovens was $16.14 per short ton, $1.00 less than in 1960. Of the oven-coke produced in Pennsylvania, a total of 13.3 million short tons was used at blast furnace plants, 156,000 tons at foundries, 147,000 tons at other industrial plants, and 24,000 tons for residential heating.

Twenty-seven beehive coke plants were in existence at yearend, but only 9 were active. A total of 1,684 beehive coke ovens was operated to produce 454,000 tons of coke from 735,500 tons of coal. Yield of coke from coal decreased from 62.86 percent to 61.73 percent. The average value of beehive coke at the ovens was $13.76 per ton, $0.42 less than that reported in 1960. The beehive coke was used in blast furnaces, by foundries, for residential heating, and for sundry industrial uses, with blast furnaces consuming the major portion of the production.

Coal produced in Kentucky, Pennsylvania, Virginia, and West Virginia was used at oven coke plants in Pennsylvania. Of the total, 57 percent came from mines in Pennsylvania, and 36 percent, from mines in West Virginia. Seventy-three percent of the coal used at oven coke plants was high volatile, 10 percent, medium volatile, and 17 percent, low volatile.

Peat.—Pennsylvania ranked fifth in value of peat production among the 22 producing States. Output in 1961 totaled 28,000 short tons and $291,000. Humus, reed-sedge, and moss peats were produced. Operations were active in Erie, Lawrence, Luzerne, and Wayne Counties. Wayne County replaced Luzerne County as the leading producer.

Petroleum and Natural Gas.—Output of crude petroleum decreased 6 percent in quantity and 3 percent in value. The average value of crude petroleum at yearend was $4.63 per barrel from the northern (Bradford) district, $4.35 from the middle (Venango) district, and $4.08 from the southwestern district.

Output of natural gas decreased 12 percent in quantity and 19 percent in value, compared with 1960.

Exploration resulted in the discovery of four new gasfields, six new gas pools, and two deeper gas pools.[4] The outstanding discovery was the Whippoorwill field in Cambria County on the southeast flank of the Sabinsville anticline. Other important discoveries were the Pavia field in Blair and Bedford Counties, the Spruell field in Fayette County, the Brooky pool in Crawford County, the Lundys Lane pool in Erie County, and the Bailey and Clarke pools in Westmoreland County. The greatest density of deep drilling occurred in Crawford County where 21 wells were drilled. Armstrong County again had the greatest number of shallow-sand completions, outside of the secondary-recovery areas, with the drilling of 46 wells. No new shallow-sand field or pool was discovered during the year.

There were 679 new gas wells drilled and 30 wells deepened. Of the 679 completions, 642 were in proven fields and 37 were exploratory tests. Of the 642 proven field wells, 211 were oil, 182 water-input, 172 gas, 8 gas-input, 10 gas-storage, and 59 dry holes. Of the 211 oil wells, 168 were drilled in connection with secondary-recovery operations.

Of the 37 exploratory tests, 12 were gas and 25 were dry. Of the 311 completions drilled outside of underground gas storage or secondary-recovery operations, 84 were dry, or 1 dry hole for slightly over 3.7 completions. The total footage drilled during the year was 1,722,955.

Acreage held by major oil and gas companies for deep oil and gas exploration amounted to 3,649,000 acres at yearend. A number of geological field parties were active; seismic crews logged 133 weeks. This was an increase of 28 percent over crew-weeks logged in 1960.

The proved recoverable crude-oil reserve was estimated at 102 million barrels on December 31—5.6 million barrels less than was reported at yearend 1960. The proved recoverable reserve of natural gas was 1,168,855 million cubic feet on December 31—23.6 percent less that at yearend 1960. Of the natural gas reserve, 691,114 million cubic feet was nonassociated reserve, 21,540 million was dissolved, and 456,201 million was stored in underground reservoirs.

Capacity for underground natural gas storage grew at a fast rate in 1961. Total capacity of reservoirs was estimated at 590.3 million cubic feet. The major portion of the storage was in Potter, Clinton, Cambria, Tioga, Washington, Greene, Armstrong, Indiana and Allegheny Counties.

Natural Gas Liquids.—Natural gas liquids produced totaled 2,725,000 gallons, a decrease of 9 percent. Output consisted of liquified petroleum gas and ethane (manufactured at natural-gasoline plants), totaling 1,453,000 gallons, and natural-gasoline and cycle products, totaling 1,272,000 gallons. Average value for liquified petroleum gases was $0.079 per gallon and for natural-gasoline and cycle products, $0.058.

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[4] Lytle, William S., Addison S. Cate, William G. McGlade, and Walter R. Wagner, Oil and Gas Developments in Pennsylvania in 1961. Pa. Topographic and Geol. Survey, Progress Report 160, 1962, 55 pp.

Reserves of natural gas liquids on December 31 were estimated at 2.1 million barrels—about 40,000 barrels less than at the end of 1960. Reserves of liquid hydrocarbon were estimated at 104.1 million barrels.

NONMETALS

Cement.—Output of the cement industry decreased. Two percent less portland cement was produced and 7 percent less masonry cement. However, shipments of both portland and masonry cement increased slightly over those of 1960.

Kilns operated at approximately 65 percent of capacity and produced 36.6 million barrels of portland cement. Of the 23 active plants, 67 percent of capacity was dry process, and 33 percent, wet process. The industry consumed 893 million kilowatts of electrical energy, about 26 million kilowatts less than in 1960. Seventy-eight percent of the electrical energy was purchased from public utility companies, compared with 72 percent in 1960. Stocks of portland cement decreased from 5.7 million barrels at the beginning of the year to 5.3 million barrels at yearend.

Masonry cement was produced at 16 of the plants that also produced portland cement, chiefly in Lehigh and Northampton Counties.

The principal raw materials used for manufacturing portland cement were cement rock and limestone. Totals of 7.2 million short tons of cement rock and 3 million of limestone were used. In addition, the following tonnages of raw material were used: Gypsum, 282,700; sand, 191,700; clays, 165,100; and iron materials, 57,000. Slag, slate, carbon black, sludge, air-entraining compounds, and grinding aids also were used.

Portland cement was shipped to consumers in Pennsylvania, 44 other States, the District of Columbia, and foreign countries. Thirty-four percent of the shipments went to Pennsylvania; 23 percent, to New Jersey; 18 percent, to New York; 6 percent, to Ohio; 6 percent, to Connecticut; 3 percent, to Maryland; 2 percent each, to Delaware, Massachusetts, and West Virginia; and 1 percent, to Virginia.

Distribution of portland cement shipments by use was as follows: 20.2 million barrels to ready-mixed concrete companies, 7 million barrels to concrete product manufacturers, 5.8 million barrels to building material dealers, 2.7 million barrels to highway contractors, 467,000 barrels to miscellaneous consumers, 444,000 barrels to other contrac-

TABLE 4.—Portland cement shipments, by counties

County	Number of plants in 1961	1960		1961	
		Barrels	Value	Barrels	Value
Lehigh	4	6,800,637	$22,739,563	6,606,106	$21,718,671
Northampton	12	17,308,898	58,327,559	18,156,481	61,222,857
Allegheny	2	6,323,448	21,754,945	6,391,919	21,831,403
Lawrence	2				
Berks	1	5,940,519	21,299,445	5,480,152	19,732,766
Butler	1				
Montgomery	1				
York	1				
Total	24	36,373,502	124,121,512	36,634,658	124,505,697

tors, and 19,000 barrels to Federal, State, and local government agencies.

Masonry cement was shipped to consumers in eastern Pennsylvania, 22 other States, and the District of Columbia. Thirty-nine percent was consumed in Pennsylvania; 18 percent, in New Jersey; 15 percent, in New York; and 13 percent, in Ohio.

Clays.—Output of clays declined to the lowest level since 1945 and was well below the record high established by the industry in 1956. A sharp drop in consumption by the refractories and construction industries resulted in a 16-percent decrease in clay production from that in 1960. Operators reported clay mined or shipped from stocks from 148 operations during the year. Output from 22 underground mines, 10 less than in 1960, accounted for 18 percent of the total clay production; the remainder came from open pits. Production was recorded in 32 counties; fire clay, in 18 counties; miscellaneous clay, in 27 counties; and kaolin, in 2 counties. Clearfield County continued as the principal clay producing county, followed in decreasing order by Lawrence, Schuylkill, Armstrong, and Jefferson Counties. Production of fire clay dropped 21 percent to the lowest annual rate of production since 1945. This decline was due to a 21-percent drop in demand for refractory materials by the steel, glass, and foundry industries and a 19-percent decrease in production of heavy clay products. Contributing factors for the decline were the lowered demand for clays used in the manufacture of cement, lightweight aggregate, and other heavy clay products. Miscellaneous clay output exceeded that of fire clay for the second year. All of the miscellaneous clay came from open pits.

Kaolin production continued in Cumberland and Blair Counties. Output increased 8 percent over 1960; this was the first increase recorded in over a decade.

TABLE 5.—Clays sold or used by producers, by kinds and uses

(Short tons)

Uses	Fire clay		Miscellaneous clay	
	1960	1961	1960	1961
Pottery and stoneware: Art pottery, flowerpots, and glaze slip	----------	----------	12,310	(1)
Refractories:				
Firebrick and block	837,233	684.376	(1)	----------
Fire-clay mortar	21,307	14,109	----------	----------
Clay crucibles	19,511	13,098	----------	----------
Foundries and steelworks	107,908	58,273	(1)	(1)
Heavy clay products	748,298	606,341	1,306,110	(1)
Portland and other hydraulic cements	----------	----------	152,126	136,430
Other uses	13	----------	(1)	(1)
Undistributed	[2] 123,711	[2] 88,423	[3] 228,901	[3] 1,398,410
Total	1,857,981	1,464,620	1,699,447	1,534,840

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.

[2] Includes floor and wall tile (1960), high-alumina brick, glass refractories, and other refractories.

[3] Includes floor and wall tile, lightweight aggregate, linoleum and oilcloth, and items indicated by footnote 1.

TABLE 6.—Clays sold or used by producers in 1961, by counties

County	Short tons	Value	Tyes of clay
Adams	71,150	$36,150	Miscellaneous clay.
Allegheny	108,785	(1)	Do.
Armstrong	212,789	2,157,671	Fire clay, miscellaneous clay.
Butler	15,710	23,565	Miscellaneous clay.
Cambria	43,014	228,581	Fire clay, miscellaneous clay.
Chester	94,390	117,988	Miscellaneous clay.
Clearfield	416,909	2,976,749	Fire clay, miscellaneous clay.
Columbia	12,398	22,316	Miscellaneous clay.
Fayette	98,404	348,024	Fire clay, miscellaneous clay.
Greene	3,000	3,750	Miscellaneous clay.
Indiana	24,635	50,502	Fire clay.
Luzerne	43,301	86,602	Miscellaneous clay.
Montgomery	86,106	140,800	Miscellaneous clay, fire clay.
Somerset	68,491	576,424	Fire clay.
Washington	10,726	26,815	Miscellaneous clay.
Undistributed [2]	1,689,652	7,605,941	
Total [3]	2,999,460	14,401,878	

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes Beaver, Berks, Blair, Bucks, Centre, Clarion, Clinton, Dauphin, Elk, Huntingdon, Jefferson, Lancaster, Lawrence, McKean, Monroe, Northumberland, Schuylkill, Snyder, and York Counties, and items indicated by footnote 1.

[3] Incomplete total; excludes kaolin produced in Blair and Cumberland Counties.

Gem Stones.—Eastern Pennsylvania continued to be the most popular source of semiprecious gem materials in the State. Semiprecious gem stones and mineral specimens were reported to have been found in Berks, Chester, Lancaster, Lebanon, Lehigh, Montgomery, and Schuylkill Counties. Most of the mineral specimens were collected by members of Pennsylvania and out-of-State mineral and lapidary clubs.

Graphite.—Crystalline graphite was recovered from schist in Chester County; production was less than that in 1960. The processed material was marketed for use in crucibles and foundry facings. In addition, manufactured (artificial) graphite powder and products were produced at a plant in St. Marys. The graphite powder was sold to basic steel manufacturers, iron and steel foundries, and to the electrochemical industry.

Iron Oxide Pigments.—Sulfur mud continued to be the only crude iron oxide pigment produced in Pennsylvania, with the output increasing in both tonnage and value. The crude material was produced in Cambria County.

Pennsylvania continued to be the leading State in producing finished natural and manufactured iron oxide pigments. Production was slightly less than in 1960. Principal natural iron oxide pigments, based on value, were brown iron oxide, burnt umber, red iron oxide, and burnt sienna. Leading manufactured iron oxide pigments were red, yellow, Venetian red, and brown. The finished natural and manufactured iron oxide pigments were produced at one plant in Carbon County and two plants in Northampton County.

Lime.—Output of lime increased slightly over 1960. Shipments of building lime were up 8 percent; agricultural lime, up 2 percent; chemical industrial lime, down less than 1 percent; and refractory lime, down 3 percent. Of the total lime sold or used, 75 percent was quicklime.

Twenty companies, 1 less than in 1960, operated 23 plants in 16 counties. Centre County continued as the leading producer with 45 percent of the State lime shipments. Centre, York, Lebanon, Chester, Butler, and Montgomery, in decreasing order, each produced lime valued in excess of $1 million. Most of the lime was consumed within the State (61 percent), but large quantities were shipped to Maryland (8 percent), New Jersey (8 percent), Ohio (6 percent), New York (5 percent), Delaware (3 percent), and Maine (2 percent).

TABLE 7.—Lime sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Centre	504,024	$6,898,746	500,707	$6,746,673
Dauphin	8,400	134,400	7,900	126,400
Franklin	2,301	17,487	1,557	11,833
Fulton	227	2,043	593	5,337
Juniata	2,100	21,000	-----	-----
Lancaster	(1)	(1)	1,198	16,772
Lebanon	176,000	2,493,500	142,000	2,070,000
Mifflin	4,315	46,363	4,349	42,521
Northumberland	475	4,000	417	3,450
Snyder	(1)	(1)	739	6,073
Undistributed [2]	422,621	6,658,973	464,698	7,867,275
Total	1,120,463	16,276,512	1,124,158	16,896,334

[1] Figure withheld to avoid disclosing individual company confidential data.
[2] Includes Armstrong, Bedford, Blair, Butler, Chester, Montgomery, and York Counties, and counties indicated by footnote 1.

Magnesium Compounds.—Magnesium carbonate, produced at Plymouth Meeting from raw dolomite, was used in producing precipitated magnesium oxide. Sales of magnesium compounds were less primarily because of lower demand for their use in manufacturing rubber and magnesium oxide insulation.

Mica.—Output of mica continued to increase primarily because of a greater demand for ground mica for use by the paint and rubber industries. The mica was mined and processed near Glenville and marketed for use in paints, as a mold lubricant for the rubber industry, and for use in welding rods.

Perlite (Expanded).—Sales of expanded perlite (15,703 short tons valued at $1,036,730) were less than in 1960. Use was in building plaster, as concrete aggregate, as loose-fill insulation, and as a soil conditioner, filler, and filter aid. The crude perlite, shipped from mines in Western States was expanded at plants in Allegheny, Delaware, Lehigh, Montgomery, and York Counties.

Pyrite.—A greater tonnage of pyrite was produced than in 1960. Pyrite concentrate, obtained as a byproduct of iron ore mining at two mines in eastern Pennsylvania, was processed to recover the pyrite and cobalt.

Sand and Gravel.—Sand and gravel output declined for the second consecutive year and was 3 percent less in quantity and 7 percent less in value than in 1960. Pennsylvania ranked 17th in tonnage and 11th in value of sand and gravel production. A total of 109 commercial operations was active, of which 34 produced 100,000 or more tons.

Production from 34 plants totaled 9,884,585 short tons valued at $15,804,195, representing 78 and 80 percent, respectively, of the State total. Sixteen operations, each producing in excess of 200,000 tons, accounted for 61 percent of the total production and 65 percent of the value. The uses of sand and gravel remained similar to those of 1960; 86 percent of the commercial output was used as building and paving sand and gravel; 56 percent was consumed as building material, and 30 percent, as paving material. South central Pennsylvania, chiefly Huntingdon and Mifflin Counties, continued as the primary area for industrial sand. Industrial sand represented 20 percent of the total sand produced, and production increased 2 percent over that of 1960. Of the total commercial sand and gravel production, 8 percent was transported by rail, 21 percent by water, and 71 percent by truck. Bucks County continued as the principal producer of sand and gravel; output decreased 3 percent from that of 1960. Other leading counties in decreasing order were Armstrong, Lycoming, Huntingdon, and Beaver.

TABLE 8.—Sand and gravel sold or used by producers, by classes of operations, and by uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Molding	(1)	(1)	147,772	$427,479
Building	3,802,203	$5,461,055	3,820,455	5,102,350
Paving	2,063,029	3,106,240	1,852,766	2,657,086
Fire or furnace	141,183	395,826	226,666	469,668
Engine	(1)	(1)	65,063	171,729
Fill	101,233	117,341	79,813	58,706
Undistributed [2]	1,241,546	4,394,246	1,095,980	3,815,356
Total	7,349,194	13,474,708	7,288,515	12,702,374
Gravel, construction:				
Building	3,369,786	4,557,919	3,175,350	4,169,641
Paving	1,992,568	2,877,280	1,941,437	2,747,338
Fill	102,029	89,725	93,294	63,316
Undistributed [3]	29,034	32,436	36,418	41,173
Gravel, miscellaneous	84,710	70,039	59,109	42,095
Total	5,578,127	7,627,399	5,305,608	7,063,563
Total sand and gravel	12,927,321	21,102,107	12,594,123	19,765,937
Government-and-contractor operations:				
Gravel: Fill	83,855	102,086		
Total	83,855	102,086		
Grand total	13,011,176	21,204,193	12,594,123	19,765,937

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.

[2] Includes glass, grinding and polishing, blast, ferrosilicon, ground, and other sand, and items indicated by footnote 1.

[3] Includes railroad ballast and other uses.

Slag (Iron-Blast Furnace).—Output of blast furnace slag decreased from 7,804,000 in 1960 to 6,699,000 short tons. The value of output also decreased, from $11,651,000 to $11,352,000. Pennsylvania continued to be the leading producer of blast-furnace slag with 26 percent of the U.S. tonnage. Of the slag processed in Pennsylvania, 5.5 mil-

TABLE 9.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Allegheny	121,113	$257,290	205,136	$353,997
Armstrong	1,516,924	3,096,258	1,462,726	3,010,348
Bedford	(1)	(1)	4,590	12,622
Blair	42,822	101,093	(1)	(1)
Bradford	(1)	(1)	290,002	405,602
Butler	161,200	221,400	136,196	158,037
Cambria	7,950	7,950	8,740	20,717
Clinton	83,855	102,086	----------	----------
Crawford	103,616	164,174	107,813	122,527
Cumberland	175,180	302,582	144,846	224,784
Fayette	166,928	280,106	119,940	202,524
Jefferson	18,857	7,911	10,000	4,200
Lackawanna	(1)	(1)	237,546	294,471
Lancaster	229,846	491,678	219,321	394,708
Luzerne	428,859	542,523	348,173	438,494
Mercer	314,821	484,178	401,165	537,918
Monroe	63,187	70,888	61,668	66,158
Northampton	425,168	498,163	523,905	627,011
Northumberland	6,853	8,096	5,215	10,025
Schuylkill	118,443	284,564	122,734	271,340
Snyder	102,940	102,801	(1)	(1)
Somerset	(1)	(1)	770	2,310
Venango	(1)	(1)	309,681	589,126
Wayne	2,678	2,411	1,679	2,017
Wyoming	(1)	(1)	448,118	438,374
York	279,647	395,222	256,725	382,111
Undistributed [2]	8,640,289	13,782,819	7,167,434	11,196,516
Total	13,011,176	21,204,193	12,594,123	19,765,937

[1] Included with "Undistributed" to avoid disclosing individual company confidential data.

[2] Includes Beaver, Berks, Bucks, Carbon, Columbia, Dauphin, Elk, Erie, Forest, Franklin, Fulton, Huntingdon, Lawrence, Lycoming, McKean, Mifflin, Montgomery, Montour, Philadelphia, and Warren Counties, unspecified counties, and counties indicated by footnote 1.

lion short tons was screened, air-cooled slag used chiefly for highway and airport construction, portland-cement concrete construction, bituminous pavements, and railroad ballast.

Stone.—Output of stone, including slate and oystershell, decreased in both tonnage and value. The lower output was due mainly to a decline in demand for dimension building stone and crushed and broken stone as riprap, fluxing stone, refractory material, and for miscellaneous uses. The demand for concrete aggregate, railroad ballast, and agricultural stone, increased.

Stone was produced in 48 counties, two less than in 1960. Northampton County continued to be the leading stone producing county. Counties having a production totaling over $3 million, in decreasing order, were Northampton, Montgomery, York, Lawrence, Adams, Centre, Chester, Lancaster, and Berks. In addition, Bucks, Dauphin, Lebanon, Delaware, and Lehigh Counties each produced over $2 million worth of stone, while Blair, Butler, Fayette, Westmoreland, and Mifflin Counties produced over $1 million each.

Output of basalt increased 16 percent in both tonnage and value, mainly because of a 17-percent increase in its use as concrete aggregate and a 19-percent increase in its use as railroad ballast. Less basalt was used as dimension building stone, and none was reported used as curbing and flagging stone, or as riprap. Dimension stone and crushed stone were produced in Bucks, Chester, and Montgomery Counties; crushed stone only was produced in Adams, Berks, Dauphin, and Delaware Counties. Delaware County led in production of crushed stone, followed by Mongomery County; Chester County was the leading source of dimension stone.

Slightly more granite was sold in 1961 than in 1960. The granite was marketed both as dimension stone and crushed stone. The use of granite as concrete aggregate increased; other uses, such as rough construction dimension stone and rubble, declined. No material was reported marketed as dressed dimension stone or riprap in 1961. Dimension granite was produced in Delaware County, and both dimension and crushed stone, in Montgomery County. No production was reported in Philadelphia County in 1961.

Output of miscellaneous stone for dimension use decreased, whereas output of crushed stone increased. The decrease in dimension miscellaneous stone was due mainly to a lower demand for rough and dressed construction material. Production of crushed miscellaneous stone increased primarily owing to a 73-percent increase in demand for its use as concrete aggregate. Dimension stone was produced in Delaware and Montgomery Counties, and crushed stone, in Montgomery and Bucks Counties. Delaware was the leading source of dimension stone, and Montgomery County, the leading source of crushed stone.

Oystershell was again collected in Berks County and marketed as poultry grit.

Sandstone, the third ranking stone in both tonnage and value, showed an overall decline in output. Crushed sandstone output decreased 10 percent in tonnage and 20 percent in value; less was used as concrete aggregate, railroad ballast, refractory material, and for sundry uses. Riprap was the only use that showed an increase in 1961. About 3 percent less dimension sandstone was marketed, with less material used as rubble and rough architectural stone. More stone was used than in 1960 as rough construction stone and as curbing and flagging stone. Sandstone was produced in 27 counties of which 21 produced crushed and broken stone and 12, dimension stone. New operations were reported in Somerset County, whereas no production was reported in Tioga County as there had been in 1960. Westmoreland continued to be the leading county for tonnage of crushed sandstone produced, followed in decreasing order by Luzerne, Blair, and Fayette Counties. Montgomery produced more dimension stone than any other Pennsylvania county. Chester and Delaware Counties also were important counties for the production of dimension sandstone. Government-and-contractor production of crushed stone was not reported in 1961.

Limestone, the ranking stone in tonnage and value, decreased 2 percent in tonnage and 4 percent in value. Limestone was marketed as both dimension and crushed stone. A 700,000-ton drop in the use of limestone as fluxing stone was a leading factor in the lower demand for crushed limestone. Also, less limestone was used as riprap and for miscellaneous uses than in 1960. Slightly more material was marketed as concrete aggregate, railroad ballast, agricultural stone, and as refractory material. The demand for dimension limestone also increased.

Crushed limestone was produced in 37 counties, the same number as in 1960. Northampton continued to lead in the production of crushed limestone, with 4.7 million tons, compared with 5 million tons in 1960. Other leading counties, each producing over 2 million tons, were, in decreasing order, Montgomery, Lawrence, York, Lancaster, and Lehigh. Value-wise, the five leading counties in decreasing order were Montgomery, York, Lawrence, Northampton, and Centre. Dimension limestone came only from Bucks County.

Output of slate for dimension uses decreased 4 percent in tonnage and increased 9 percent in value. Use of slate for roofing, billiard table tops, school slates, structural and sanitary purposes, and as flagging stone increased, but use of slate for blackboards and bulletin boards decreased. Dimension slate came from Northampton and Lehigh Counties, with the major portion of the production coming from Northampton County. Crushed slate was marketed from Northampton, Lycoming, and York Counties; total sales were less than in 1960.

Output of natural and artificially colored roofing granules decreased in both tonnage and value compared with 1960, owing mainly to decreased demand for natural granules. Of the total production, artificially colored granules represented 80 percent, compared with 76 percent in 1960. Plants were active in Adams, Beaver, and York Counties.

TABLE 10.—Stone sold or used by producers, by uses

Use	1960		1961	
	Short tons	Value	Short tons	Value
Dimension stone:				
Building stone	153,304	$1,142,813	143,644	$1,128,525
Curbing and flagging	12,493	306,897	11,372	278,501
Other uses	48,834	3,165,132	46,891	3,445,385
Total	214,631	4,614,842	201,907	4,852,411
Crushed and broken stone:				
Riprap	51,842	74,834	(1)	(1)
Concrete and road metal	20,363,634	31,284,466	21,342,700	31,563,484
Furnace flux (limestone)	5,637,623	10,657,545	4,924,382	8,953,062
Railroad ballast	569,253	913,223	641,882	1,003,118
Agricultural	950,509	2,852,574	1,078,392	2,973,326
Other uses [2]	14,348,797	23,770,386	13,645,002	21,998,505
Total	41,921,658	69,553,028	41,632,358	66,491,495
Grand total	42,136,289	74,167,870	41,834,265	71,343,906

[1] Figure withheld to avoid disclosing individual company confidential data.
[2] Includes refractory and items indicated by footnote 1.

Sulfur.—Byproduct sulfur continued to be recovered in the liquid purification of oil refinery gases obtained from domestic and foreign sources. Shipments totaled 35,795 long tons of sulfur equivalent valued at $836,000. This was slightly less than that marketed in 1960. The Sinclair Refining Co., Marcus Hook refinery, and the Gulf Oil Corp., Philadelphia refinery, used the Claus process to recover sulfur. Sulfur also was recovered at the Sun Oil Co., Marcus Hook refinery, using a two-stage catalytic oxidation of hydrogen sulfide.

TABLE 11.—Stone sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Adams, Cumberland, York	4,966,944	$10,520,679	5,001,344	$10,420,308
Armstrong	(1)	(1)	50,111	100,094
Berks	2,559,740	3,431,652	2,672,193	3,409,104
Blair, Huntingdon	1,196,838	3,107,357	1,149,020	2,070,070
Bucks	(1)	(1)	1,513,394	2,756,661
Butler	829,202	1,647,700	715,986	1,390,315
Cambria	4,800	15,400	4,000	14,000
Carbon, Monroe, Schuylkill	497,376	1,901,063	555,742	1,847,976
Centre	1,889,695	3,806,576	1,972,355	3,950,176
Chester	2,341,341	4,770,842	2,087,985	3,890,230
Dauphin	1,467,521	2,332,238	1,478,325	2,313,959
Fayette, Somerset	530,651	1,135,453	772,894	1,592,048
Franklin	608,415	994,155	533,193	854,227
Juniata, Miflin, Snyder	798,124	1,539,381	799,172	1,458,543
Lackawanna	5,072	10,144	(1)	(1)
Lancaster	2,292,968	3,263,486	2,586,503	3,733,888
Lawrence	2,912,743	5,017,918	2,665,362	4,407,352
Lebanon	1,669,667	2,816,853	1,294,165	2,283,741
Lehigh, Northampton	7,257,026	9,470,565	6,921,657	9,467,198
Luzerne	195,248	310,969	149,407	234,993
Mercer	14,211	49,971	17,264	59,702
Montgomery	4,006,352	7,129,105	3,959,509	6,757,063
Northumberland	43,880	77,159	42,334	73,884
Philadelphia	11,350	28,815	---	---
Union	278,933	461,463	333,675	538,017
Wayne	199,124	357,299	99,948	191,048
Westmoreland	567,955	1,023,678	(1)	(1)
Wyoming	2,161	50,400	(1)	(1)
Undistributed [2]	[3] 4,988,952	[3] 8,897,549	4,458,727	7,529,309
Total	42,136,289	74,167,870	41,834,265	71,343,906

[1] Figure withheld to avoid disclosing individual company confidential data.

[2] Includes Allegheny, Bedford, Clarion, Clinton, Delaware, Fulton, Lycoming, Montour, Perry, Potter, Susquehanna, Tioga (1960), and Washington Counties, and counties indicated by footnote 1.

[3] Revised figure.

The Atlantic Refining Co. Philadelphia refinery recovered hydrogen sulfide by the Girdler process and burned it to sulfur dioxide for use in making sulfuric acid at the local plant.

Output of byproduct sulfuric acid (100 percent H_2SO_4) at zinc smelters and zinc roasters was slightly higher than in 1960.

Talc.—Output of pyrophyllite (sericite schist) decreased, although sales of sericite schist were greater due to an increase in demand for this material as a filler in asphaltic compounds and joint cement. Production was supplemented with ground material from stock accumulations. The sericite schist was produced at two locations in Adams County and at one location in Cumberland County. The material was processed at a mill in Aspers, Adams County.

Tripoli.—The output of tripoli (rottenstone) was slightly higher. The crude material was ground at two plants in Lycoming County and was marketed principally as a buffing compound and as a filler.

Vermiculite (Exfoliated).—Crude vermiculite from Western States and foreign countries continued to be exfoliated at plants in Bucks and Lawrence Counties. The exfoliated vermiculite was marketed for sundry uses, including insulation, refractories, concrete aggregate, plaster aggregate, and insulation cement.

METALS

Beryllium.—The Beryllium Corp., with operations in Reading and Hazleton, was one of two companies in the United States that processed beryl to beryllium metal, alloys, and compounds. Most of the output was beryllium metal and beryllium-copper alloys.

Cadmium.—Cadmium continued to be recovered from flue dust collected at the St. Joseph Lead Co. Josephtown plant and the New Jersey Zinc Co. Palmerton smelter.

Cobalt.—Output of cobalt as a byproduct of iron ore mining was less than in 1960.

Copper.—Production of copper was higher than in 1960. The copper was recovered in a concentrate produced at the Lebanon concentrator and shipped to a smelter in New York.

Ferroalloys.—Production and shipments of ferroalloys were less than in 1960. Shipments totaled 439,360 short tons valued at $100,343,871. Ferromanganese and spiegeleisen were the leading types of ferroalloys marketed. In addition, smaller quantities of ferrotungsten, chromium-manganese-tungsten, aluminum-vanadium, ferrovanadium, ferroboron, ferrocolumbium, nickel-columbium, ferromolybdenum, molybdenum-aluminum, and aluminum-chromium-vanadium were shipped.

Gold and Silver.—Output of gold and silver decreased. Both metals were recovered from a copper concentrate produced at the Lebanon concentrator of Bethlehem Steel Co., near Lebanon.

Iron Ore.—Shipments of usable iron ore increased. Magnetite produced at the Cornwall and Grace underground mines was shipped to the Lebanon and Morgantown concentrators, respectively, for processing. Shipments from these plants consisted of concentrates and agglomerates for use in producing pig iron and sinter. Pelletizing plants were completed at Lebanon in 1950 and at Morgantown in 1961. Construction of a new concentrating plant at the Cornwall mine, continued.

Iron and Steel Scrap.—Consumption of ferrous scrap totaled 12,483,000 short tons, an 8-percent drop from that of 1960. Ferrous scrap was collected and prepared chiefly in the larger metropolitan areas such as Harrisburg, Philadelphia, and Pittsburgh. The leading varieties of scrap processed and shipped were No. 1 heavy melting steel, No. 2 and all other bundles, cast-iron scrap and other borings, and No. 1 and electric furnace bundles. Stocks of ferrous scrap held by all consumers at yearend totaled 1,846,000 tons.

Pig Iron.—Pig iron output totaled 15.2 million short tons, about 1 million tons less than in 1960. The pig iron was produced by 12 companies at 20 plants having a total of 72 stacks. Foundry, basic, bessemer, low-phosphorus, malleable, and direct-casting types of pig iron were produced.

More basic and bessemer pig iron was produced than any other classes; basic represented 89 percent of the total (13.5 million short tons) and bessemer represented 7 percent (966,000 tons). In the blast furnaces, raw material consumption totaled 5.6 million tons of domestic iron ore, 2.9 million tons of foreign iron ore, 3.2 million tons of limestone and dolomite, 728,000 tons of mill cinder and roll scale, 22,000 tons of flue dust, 1.1 million tons of open-hearth bessemer slag, 10.6 million tons of coke, 61,000 tons of pig iron, 888,000 tons of home and purchased scrap, and 209,000 tons of slag scrap. In addition, manganiferous ore, coke breeze, anthracite, sinter, self-fluxing agglomerates, pellets, and foreign agglomerates were consumed in making pig iron. A total of 3.8 million tons of domestic iron ore, 5.3 million tons of foreign iron ore, 326,000 tons of mill cinder and roll scale, 992,000 tons of flue dust, and 145,000 tons of anthracite and quantities of foreign manganiferous ore, limestone, dolomite, and coke breeze were consumed in agglomerating plants in Pennsylvania to produce sinter and self-fluxing agglomerates.

Smelters.—The Palmerton and Josephtown smelters were active. The Palmerton plant of The New Jersey Zinc Co. processed concentrate from company operations at Friedensville, Pa.; Austinville, Va.; Jefferson City and Treadway, Tenn.; Canyon City, Colo., and other domestic and foreign sources. Both zinc and lead were produced, with zinc the primary product of the smelter. Three Waelz kilns for treating crude ore and byproduct materials resumed operation after 2½ years of idleness. Progress was made on the installation of electric furnaces for the production of spiegeleisen. The Josephtown plant of St. Joseph Lead Co. processed zinc concentrate received from company operations at Edwards and Balmat, N.Y., and at Indian Creek and Leadwood, Mo., as well as material from other States and foreign countries. The furnace stack was relined during the summer months. The zinc content of metal produced at the smelter was 141,209 tons, compared with 146,732 tons in 1960. In December, work began on a new and larger furnace to replace two smaller, less efficient furnaces.

Zinc.—Production of zinc concentrate increased 70 percent partly because of improved demand for zinc products in the second half of the year and partly because of strikes in 1960 during which no production was obtained. The ore produced at the Friedensville mine was concentrated at a nearby plant, and the concentrate was shipped to the Palmerton smelter for processing. Mine drainage problems continued to persist, but adequate pumping capacity permitted continuation of ore extraction at various mine levels. Some new stoping areas were being developed, but poor ground conditions retarded the progress.

REVIEW BY COUNTIES

Adams.—Total stone output was 8 percent less than in 1960. Limestone, chiefly for use as blast-furnace flux, concrete aggregate, roadstone, agricultural stone, and stone sand, was mined and crushed at a quarry and plant west of Hanover, by Bethlehem Limestone Co., a subsidiary of Bethlehem Steel Co. Teeter Stone, Inc., a subsidiary of Harry T. Campbell Sons Corp., Gettysburg, quarried and crushed limestone for concrete aggregate and roadstone. Quantities of roadstone were sold under contract to nearby State Government projects. The Funkhouser Mills, Division of the Ruberoid Co., continued to operate the Charmian quarry (basalt) east of Charmian and the nearby Greystone quarry (quartzite). The stone was crushed and ground for use as roofing granules, tennis court surfacing, and asphalt filler.

TABLE 12.—Value of mineral production in Pennsylvania [1] [2] [3]

County	1960	1961	Minerals produced in 1961 in order of value
Adams	(4)	(4)	Stone, sericite schist, clays.
Allegheny	(4)	(4)	Cement, coal, clays, sand and gravel, stone.
Armstrong	(4)	(4)	Coal, sand and gravel, clays, stone, lime.
Beaver	(4)	(4)	Coal, clays, sand and gravel.
Bedford	(4)	$1,684,944	Coal, stone, lime, sand and gravel.
Berks	$13,229,516	23,526,165	Iron ore, cement, stone, clays, coal, cobalt, pyrite, sand and gravel.
Blair	(4)	2,346,205	Stone, lime, coal, clays, sand and gravel.
Bradford	(4)	(4)	Sand and gravel, coal.
Bucks	(4)	(4)	Sand and gravel, stone, clays.
Butler	14,099,030	13,675,837	Coal, cement, lime, stone, sand and gravel, clays.
Cambria	40,686,920	36,582,851	Coal, clays, sand and gravel, stone, iron ore (pigment material).
Cameron	292,965	197,349	Coal.
Carbon	(4)	(4)	Coal, stone, sand and gravel.
Centre	(4)	(4)	Lime, coal, stone, clays.
Chester	(4)	(4)	Stone, lime, clays, graphite, gem stone.
Clarion	(4)	11,623,425	Coal, stone, clays.
Clearfield	27,526,100	27,959,810	Coal, clays.
Clinton	2,343,929	1,836,656	Coal, stone, clays.
Columbia	(4)	(4)	Coal, sand and gravel, clays.
Crawford	164,174	122,527	Sand and gravel.
Cumberland	(4)	(4)	Stone, sand and gravel, clays, sericite schist.
Dauphin	3,918,994	3,690,751	Stone, coal, clays, sand and gravel, lime.
Delaware	(4)	(4)	Stone.
Elk	1,243,645	1,407,929	Coal, clays, sand and gravel.
Erie	(4)	(4)	Sand and gravel, peat.
Fayette	(4)	(4)	Coal, stone, clays, sand and gravel.
Forest	(4)	(4)	Sand and gravel.
Franklin	(4)	(4)	Stone, sand and gravel, lime.
Fulton	(4)	(4)	Do.
Greene	63,349,280	60,582,351	Coal, clays.
Huntingdon	4,834,112	3,796,577	Sand and gravel, coal, stone, clays.
Indiana	(4)	23,177,337	Coal, clays.
Jefferson	(4)	(4)	Coal, clays, sand and gravel.
Juniata	(4)	(4)	Stone.
Lackawanna	(4)	(4)	Coal, sand and gravel, stone.
Lancaster	(4)	(4)	Stone, coal, sand and gravel, clays, lime, gem stone.
Lawrence	(4)	(4)	Cement, stone, coal, clays, sand and gravel, peat.
Lebanon	16,272,894	(4)	Iron ore, lime, copper, stone, cobalt, pyrite, coal, gold, silver, gem stone.
Lehigh	(4)	(4)	Cement, zinc, stone, gem stone.
Luzerne	(4)	(4)	Coal, sand and gravel, stone, peat, clays.
Lycoming	1,489,284	1,759,556	Stone, sand and gravel, coal, tripoli.
McKean	439,400	371,979	Clays, sand and gravel, coal.
Mercer	3,156,941	3,958,718	Coal, sand and gravel, stone.
Mifflin	(4)	(4)	Stone, sand and gravel, lime.
Monroe	(4)	(4)	Stone, clays, sand and gravel.
Montgomery	14,071,756	12,645,092	Stone, cement, lime, clays, sand and gravel, gem stone.
Montour	(4)	(4)	Stone, sand and gravel.
Northampton	(4)	(4)	Cement, stone, sand and gravel, coal.
Northumberland	(4)	(4)	Coal, clays, stone, sand and gravel, lime.
Perry	(4)	(4)	Stone.
Philadelphia	(4)	(4)	Sand and gravel.
Potter	(4)	(4)	Stone.
Schuylkill	54,881,224	55,035,930	Coal, stone, sand and gravel, clays, gem stone.
Snyder	614,357	509,860	Clays, stone, coal, sand and gravel, lime.
Somerset	(4)	(4)	Coal, clays, stone, sand and gravel.
Sullivan	97,845	90,334	Coal.
Susquehanna	(4)	(4)	Stone, coal.
Tioga	(4)	1,340,683	Coal.
Union	461,463	538,017	Stone.
Venango	(4)	2,222,660	Coal, sand and gravel.
Warren	(4)	(4)	Sand and gravel.
Washington	(4)	(4)	Coal, stone, clays.
Wayne	(4)	340,653	Stone, peat, coal, sand and gravel.
Westmoreland	19,823,493	(4)	Coal, stone.
Wyoming	(4)	(4)	Sand and gravel, stone.
York	13,814,831	14,591,689	Cement, stone, lime, sand and gravel, clays, mica.
Undistributed	[5] 526,547,379	486,031,882	
Total	[5] 823,360,000	791,648,000	

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[1] Pike County is not listed because no production was reported.

[2] Excludes value of production for LP gases, natural gasoline, petroleum, natural gas, and some gem stone and sand and gravel unspecified by counties; included with "Undistributed."

[3] Excludes value of clays and stone used in manufacturing lime and cement.

[4] Included with "Undistributed" to avoid disclosing individual company confidential data.

[5] Revised figure.

Summit Industries, Inc., operated two open-pit mines near Mount Hope and Bendersville to produce sericite schist. The crude material was trucked to the company plant at Aspers to be crushed, screened, and ground, chiefly for use as a filler in asphaltic compounds and joint cement. Mauna Mining Corp. had spent the last 2 years in development of an open-pit mine near Idaville to produce sericite schist. Production was expected to begin in 1962. The Liberty Stone Co. soapstone operation near Fairfield was inactive during the year.

Miscellaneous clay production remained virtually the same as in 1960. Alwine Brick Co., New Oxford, and Gettysburg Drain Tile Works, Gettysburg, mined miscellaneous clay from open pits and used the clay for making building brick and drain tile, respectively.

Allegheny.—Cement shipments continued to decline. Greenbag Cement Co., Division of Marquette Cement Manufacturing Co., at its Neville Island plant, manufactured mostly slag portland cement and some masonry cement by the wet process. Universal Atlas Cement, Division of United States Steel Corp., manufactured portland and masonry cements using the dry process at the company plant at Universal. Major shipments were by truck, mostly intrastate and to West Virginia and Ohio.

Both underground and strip mines were operated to produce bituminous coal. About 90 percent of the output was from underground mines. Twenty-one underground mines were active—four less than in 1960 and eight less than in 1959. A total of 38 cutting machines cut 4.3 million tons of coal, and about the same quantity of coal was mechanically loaded by 89 loading machines. Of the mechanically cleaned coal, 29 percent was washed, using jigs. Twenty-three strip mines, one more than 1960, produced coal, using 38 power shovels and 6 draglines. Most of the draglines and shovels had a capacity of less than 3 cubic yards.

Production of miscellaneous clay, continuing the decline which began in 1958, was 60 percent below the previous high of 1957. Four companies mined clay for their own use in the manufacture of building brick. Milliken Brick Co., Inc., the largest clay producer, mined clay from pits near Pitcairn and Wilkinsburg. Smaller quantities of miscellaneous clay were recovered near Bridgeville, Creighton, and McKeesport.

Despite labor strikes in the construction industry in western Pennsylvania and adverse weather conditions in the early part of the year, output of sand and gravel rose to its greatest height since 1956. Output from four producers totaled 205,000 tons and represented a 69-percent increase over that of 1960. Materials processed were used for construction and industrial purposes.

Nick Gioia, Buena Vista, produced dimension sandstone as rubble. Malli Mines produced dimension sandstone as irregular-shaped building stone and as flagging stone from a quarry in Jefferson Borough. Perlite, obtained from mines in Utah and New Mexico, was expanded by Panacalite Perlite Co., Pittsburgh, and Perlite Manufacturing Co., Carnegie. The material was sold or used for building plaster aggregate.

Armstrong.—Forty-five underground bituminous coal mines, 46 strip mines, and 11 auger mines were active. This was a decrease of nine underground mines and an increase of seven strip mines and one auger mine. Slightly more coal was produced from underground mines than from strip mines. Of underground production, 99 percent was mechanically loaded, using 42 loading machines. Pneumatic, other washing methods, and jigs, in decreasing order, were used for cleaning the coal. Sixty-six power shovels and 21 draglines were operated; 55 of the power shovels had a capacity of less than 3 yards, 10, a capacity of 3 to 5 yards.

Armstrong County continued as the second-ranking sand and gravel producing county and was the center of the industry in southwestern Pennsylvania. The output, from four plants, was used primarily as structural and paving material; a small quantity of the sand and gravel produced was shipped to consumers as unprepared material.

Although the quantity and value of clay production declined, the county ranked fourth in tonnage and second in value of clay output. Six underground mines, one each at Adrian, Freeport, Templeton, and New Bethlehem and two at Kittanning, supplied clay used to produce firebrick and block and heavy clay products. Clays obtained from open-pit operations at Apollo, Craigsville, and Worthington were used in manufacturing heavy clay products.

Two producers, both near Kittanning, quarried and crushed limestone solely for use in making lime. Beaver Run Limestone Co., Apollo, produced crushed and broken limestone for use as concrete aggregate and roadstone. Three operators near Kittanning produced hydrated lime and sold it for agricultural purposes. Walter Hershberger discontinued lime operations during the year.

Beaver.—Underground, strip, and auger mines produced bituminous coal; the largest production came from 13 strip mines using 18 power shovels and 9 draglines. At the underground mines, two cutting machines and two mechanical loading machines were used; all of the underground production was mechanically loaded. Jigs and other mechanical wet washing methods were used to clean the coal.

Clay output declined substantially from that of 1960, and was well below the quantity reported in 1956 when Beaver County ranked first in production of clays. Three of four underground mines were active during the year and supplied 68 percent of the clay produced. Eight open pits were nonproductive during the year; six of these were closed, and temporary shutdowns were reported for pits operated by Kaiser Refractories and Chemicals Division of Kaiser Aluminum and Chemical Corp. and McQuiston Coal Co.

Combined output of sand and gravel reported by three producers was substantially lower than in 1960; however, Beaver County was the fifth largest sand and gravel producing county. Building and paving sand and gravel was processed and shipped to consumers by waterway and truck. Central Commercial Co. made artificially colored roofing granules at Darlington, using shale as raw material.

Bedford.—Twenty-one underground mines and two strip mines produced bituminous coal. Of the undergound production, 46 percent was mechanically loaded; none was mechanically cleaned. At the strip mines, four power shovels, three draglines, and three bulldozers were used.

Stone output increased 29 percent over that of 1960. Three companies produced limestone at quarries near Everett, New Paris, and Hyndman, chiefly for use as agricultural stone, concrete aggregate, roadstone, and for the manufacture of lime. Leap Ganister Rock Co. produced ganister rock at its No. 1 quarry near Madley. The stone was crushed and sized at a local plant for use as furnace or converter linings.

J. Mason Kerr, Hyndman, produced and sold quicklime, using a one-pot kiln at its Hyndman plant. New Enterprise Stone & Lime Co. produced and sold hydrated lime for agricultural purposes at its Ashcom plant near Everett. Feight Bros. recovered sand from a pit near Everett and processed it at an adjacent plant for use as building material.

Berks.—Bethlehem Cornwall Corp., a subsidiary of Bethlehem Steel Co., continued operating its Grace undergound mine near Morgantown, producing crude magnetite ore mainly by block caving. The crude ore was processed at the local company plant using flotation and magnetic concentration.

Shipments and value of portland cement increased 12 and 10 percent, respectively. Allentown Portland Cement Co. produced portland and masonry cements at its No. 1 five-kiln plant in Evansville. Finished cement was shipped mostly by railroad to consumers in Pennsylvania, New Jersey, Connecticut, and New York.

A total of 2,672,000 tons of stone was produced, a 4-percent increase over the 1960 figure. Four companies quarried and crushed limestone at six operations—two near Evansville and one each near Kutztown, South Temple, Sinking Spring, and Oley. The stone was sold or used directly as concrete aggregate and roadstone and in the manufacture of cement. Quantities of the roadstone were sold under contract for use at nearby State Government projects. Eighty-four percent of the output was shipped by truck. Reading Poultry Food Co., Reading, crushed oystershell for use as poultry grit. Basalt, produced by John T. Dyer Quarry Co. at the Clingan quarry, Birdsboro, was crushed and sized at a local plant for railroad ballast and roadstone. Diabase was quarried chiefly for roadstone, near Douglassville and Morgantown. Sandstone from a quarry near Bechtelsville was crushed and sold for use as concrete aggregate and roadstone.

Glen-Gery Shale Brick Corp. produced miscellaneous clay from open pits near Wyomissing and Shoemakersville for use in the manufacture of building brick.

A small quantity of anthracite was recovered by river dredging.

Two producers operated fixed plants, one near Sinking Spring and the other near Temple, to produce sand and gravel for building and paving use. Gem-quality pink and green feldspar, magnetite, zircon, and epidote were collected near Lobachsville and west of Boyertown, primarily as a hobby.

Blair.—Production and value of stone was slightly higher than in 1960. Crushed limestone was produced by six companies operating seven quarries near Roaring Spring, Hollidaysburg (3), Altoona, Claysburg, and Duncansville. Output was sold or used directly for roadstone and agricultural purposes. The leading producer was New Enterprise Stone & Lime Co. Quartzite was quarried and crushed for use in making silica brick by General Refractories Co., Frankstown, and J. L. Hartman, Sproul. Basalt Trap Rock Co., Williamsburg, quarried and crushed quartzite chiefly for railroad ballast and road material. West Virginia Pulp & Paper Co., a new lime producer in the county, produced quicklime at its plants at Tyrone and Williamsburg and used the lime for manufacturing paper.

Two underground bituminous coal mines and one strip mine were operated. The largest part of the coal came from the strip mine, at which two power shovels and one dragline were operated.

Blair County was one of two counties producing kaolin. Kaolin, mined near Williamsburg, was used to manufacture refractories. A small quantity of plastic fire clay was mined at an open pit near Martinsburg. Two plants near Hollidaysburg processed sand for construction use.

Bradford.—J. A. Eck & Sons, Inc., and Towanda Sand & Gravel Corp. produced building and paving sand and gravel from pits near Towanda. One strip mine was operated for the production of bituminous coal.

Bucks.—Output of sand and gravel declined for the second consecutive year; it was 3 percent below that of 1960 but Bucks County remained the leading county in both tonnage and value of production. Sand and gravel was processed primarily for use as building and paving material; a small quantity of molding sand was produced near Tullytown. The Sand & Gravel Division of Warner Co., Tullytown, was the principal producer in the State. Sand and gravel was transported to consumers by truck, waterway, and railroad.

Five quarries near Rushland, Eureka, New Hope, Langhorn, and Buckingham, produced limestone solely for use as concrete aggregate and roadstone. Some dimension limestone for use as rough construction stone was quarried near Langhorn. Coopersburg Granite Co., east of Coopersburg, quarried dimension black diabase for dressed architectural and monumental stone. Edison Quarry, Edison, quarried dimension diabase for use as rough and dressed construction stone and also crushed quantities of the diabase for use as road material. Four operators near Weisel, Telford, Quakertown, and Ottsville, quarried and crushed diabase principally for concrete aggregate and roadstone and a small quantity for railroad ballast. Samuel M. Yoder Estate operated the Blooming Glen quarry and crushing plant, producing bluestone and redstone, and George Wiley operated the Wiley's quarry near Point Pleasant, producing bluestone. Both companies quarried and crushed sandstone for use as concrete aggregate and roadstone. Delaware Quarries, Lumberville, produced and sold dimension sandstone as irregular-shaped construction stone.

Quakertown Brick & Tile Co., Inc., recovered shale from an open pit near Quakertown and used the material to manufacture building brick.

Vermiculite imported from the Union of South Africa was processed by Hyzer & Lewellen at the company's Southampton plant. The material was used directly or marketed primarily as concrete and plaster aggregate and residential insulation products.

Butler.—Bituminous coal was produced from 22 underground mines, 41 strip mines, and 6 auger mines. This was 2 less underground mines, 4 more strip mines, and 1 more auger mine than were active in 1960. Thirty-seven cutting machines and 15 loading machines, 1 each less than in 1960, were used at the underground mines; 74 percent of the underground production was mechanically loaded. Sixty-seven power shovels and 35 draglines, 1 carryall, and 58 bulldozers were used at the strip mines. Sixty of the power shovels and 10 of the draglines had a capacity of less than 3 cubic yards, while 7 power shovels and 12 draglines had a capacity of 3 to 5 cubic yards. About 25 percent of the coal was mechanically cleaned, principally by jigs.

Penn-Dixie Cement Corp. used captive crushed limestone for manufacturing Types I-II and III portland cement and some masonry cement, using the wet process, at its No. 9 plant, West Winfield. Finished cement was shipped mostly by truck, in bulk, to ready-mixed concrete companies, intrastate.

Mercer Lime & Stone Co. produced quicklime and hydrated lime at its plant one-half mile west of Branchton. Quicklime and hydrated lime was marketed for chemical and industrial uses, and some hydrated lime was sold for agricultural purposes. Output of limestone continued to decline, although five companies, one more than in 1960, operated quarries near Harrisville, Portersville, West Winfield (2), and Branchton. The crushed limestone was used for concrete aggregate, roadstone, cement manufacture, and agricultural purposes.

Construction sand and gravel was prepared at plants near Slippery Rock. Shale recovered by Scott Borland Brick Yard from an open pit near Mars was used in the manufacture of building brick.

Cambria.—Bituminous coal was produced from 87 underground mines, 21 strip mines, and 1 auger mine. This was 1 less underground mine, 2 less strip mines, and 3 less auger mines than were worked in 1960. Ninety-three percent of the production came from underground mines. One hundred and eleven cutting machines, 31 less than in 1960, and 144 loading machines, 38 less than in 1960, were used at the underground operations; 97 percent of the underground production was mechanically loaded. Forty-one power shovels, 13 draglines, and 27 bulldozers were used at the strip mines. Approximately 81 percent of the coal was mechanically cleaned using pneumatic and other wet washing methods.

Clays mined from two underground operations at Patton and South Fork and two open pits at Johnstown and Hastings declined 16 percent from that of 1960. Fire clay was used for building brick, vitrified sewer pipe, and refractories. Parry Sand & Gravel Co., Johnstown, processed sand and gravel for construction use. Sandstone, crushed and broken for use in making silica brick and as road material, was quarried near Johnstown. Crude iron oxide pigments of the sulfur-mud variety were produced at the No. 31 mine near Twin Rocks for use in making paint pigments.

Cameron.—The entire production of bituminous coal came from one strip mine. Three power shovels, one dragline, and three bulldozers were used at this mine.

Carbon.—Anthracite from underground mines, strip pits, culm banks, and river dredging decreased 17 percent from the 1960 output. More than 83 percent of the production was shipped by rail. The principal producers of anthracite were Sullivan Trail Co., Greenwood Stripping Co., Honeybrook Mines, and Admiral Coal Co.

North American Refractories recovered quartzite at the Little Gap quarry and crushed the stone at the Palmerton plant for use in making silica brick. James and Paul Fauzio quarried and crushed sandstone at the Red Rock quarry and stationary plant near Nesquehoning and sold the stone for road material. Alliance Sand Co., Inc., a subsidiary of Martin Marietta Corp., operated its pit and plant near Palmerton, producing prepared sand for paving, cement manufacture, and other building uses. Other plants produced smaller quantities of construction sand and gravel.

Centre.—Despite a continued but slight decline in quantity and value of lime, Centre County was again the leading lime-producing county. Three producers operated rotary kilns near Bellefonte. Quicklime and hydrated lime were marketed chiefly for chemical and industrial uses, with smaller quantities for agricultural and construction uses.

Fourteen bituminous coal strip mines and 13 underground mines were active. This was three less strip mines, two less auger mines, and two more underground mines than in 1960. About 95 percent of the coal output came from strip mines using 41 power shovels, 13 draglines, and 14 bulldozers. At the underground operations, five cutting machines and two loading machines were used; 36 percent of the underground production was mechanically loaded. None of the production was mechanically cleaned.

Limestone, the only stone produced increased 4 percent in both tonnage and value; total output was approximately 2 million short tons. The principal uses of the limestone were for concrete aggregate, roadstone, lime manufacture, and open-hearth flux. Six companies produced crushed and broken limestone, principally from quarries near State College, Bellefonte, and Pleasant Gap. Fifty-five percent of the stone produced was shipped by truck; the remainder was shipped by railroad or consumed at the local plants. Harbison-Walker Refractories Co. produced a small quantity of fire clay at the Blair clay pit.

Chester.—Quantity and value of stone decreased 11 percent and 18 percent, respectively, although output continued to exceed 2 million short tons. Bradford Hills Quarry, Inc., crushed limestone near Downingtown for use as road material. Some of the stone was sold to local Government agencies for road construction. The Cedar Hollow quarry and plant at Devault, operated by Warner Co., Bellefonte Division, yielded crushed limestone for use as road material, blast-furnace flux at chemical plants, and agricultural stone and in manufacturing refractories and lime. Quicklime and hydrated lime, chiefly for sewage and trade-waste treatment, agricultural use, and paper manufacture, were produced at the Cedar Hollow plant. The Warner Co. Johnson quarry and plant near Paoli yielded limestone solely for use as concrete aggregate and roadstone. Valley Forge Stone Co. produced and crushed limestone at its quarry and plant near Malvern, solely for use as roadstone.

French Creek Granite Co., Saint Peters, quarried and dressed dimension stone (black diabase) for use as architectural stone, ornamental stone for monuments and mausoleums, and industrial surface plates. Three producers near Delaware, Cornog, and Elizabethville produced and crushed diabase principally for use as concrete aggregate and roadstone. Abram T. Minor, John Fecondo & Sons, and Albert Rotunno quarried dimension sandstone (bluestone) as irregular-shaped construction stone, flagging stone, and rubble. Dimension sandstone was quarried near Malvern by Bacton Hill Quarry and sold, or used directly, as irregular-shaped construction stone and rubble. Some of the stone was used on the exterior and interior of buildings at the Cherry Hill Shopping Center, Cherry Hill, N.J., and the Dublin Lutheran Church, Dublin, Pa.

Installation of a heavier crusher and improved grinding, screening, and storage facilities enabled McAvoy Vitrified Brick Co. to process a greater quantity of miscellaneous clay and shale for the manufacture of building brick.

Crystaline flake graphite for use in crucibles and foundry facings was produced near Chester Springs by Graphite Corp. of America. Mineral specimens including galena, dewylite, acrocryptite, clinozoisite, kyanitic quartz, and allanite were collected near Phoenixville, West Chester, and Cornog.

Clarion.—Clarion County again ranked second in strip mining of bituminous coal, with 14 percent of the State's strip-mine tonnage. Sixty-seven power shovels, 36 draglines, and 37 bulldozers were used at the 30 active strip mines. Sixty of the 67 power shovels had a capacity of less than 3 cubic yards, and 7 had a capacity of 3 to 5 cubic yards. Eighteen of the 36 draglines had capacities of 3 to 5 cubic yards; 11, 6 to 12 cubic yards; 5, less than 3 cubic yards; and 2, 12 cubic yards. Seven cutting machines and three loading machines were used at the underground mines where 52 percent of the coal was mechanically loaded. Forty-two percent of the coal produced in the county was mechanically cleaned. Of the coal mechanically cleaned, 54 percent was cleaned by use of jigs.

Limestone for use as concrete aggregate and roadstone, and for agricultural purposes was produced by Allegheny Mineral Corp. at a quarry and plant east of Parker. Emlenton Limestone Co. produced limestone at a quarry near Turkey City for use as roadstone.

Clay production decreased considerably from the 1960 figure, and was the least since 1958. Fire clay was produced by Frank Pope Co. and Climax Division of A. P. Green Fire Brick Co. from underground mines near New Bethlehem and north of Climax, respectively. Stahlman Coal Co. announced that it had abandoned its Bish clay pit, but it did recover fire clay from the Horlung property near Corsica, Pa. New Bethlehem Tile Co. mined both fire clay and miscellaneous clay from a property near New Bethlehem. Fire clay was used in manufacturing firebrick and block, mortar, building brick, and other heavy clay products; miscellaneous clay was used to make tile and building brick.

Clearfield.—Clearfield County continued to lead in the production of bituminous coal from strip mines. One hundred and one strip mines were active, five less than in 1960. A total of 214 power shovels, 90 draglines, 164 bulldozers, 32 horizontal power drills, and 30 vertical power drills were used at the strip operations. Of the power shovels, 199 had a capacity of less than 3 cubic yards; 14, 3 to 5 cubic yards; and 1, 6 to 12 cubic yards. Of the draglines, 29 had a capacity of less than 3 cubic yards; 33, 3 to 5 cubic yards; 23, 6 to 12 cubic yards; and 5, over 12 cubic yards. Seventy-two underground mines, 10 less than in 1960, were operated for the production of bituminous coal. A total of 99 cutting machines and 51 loading machines were used. Of the coal mined underground, 1.2 million tons was cut mechanically, and 895,000 tons was loaded mechanically. A total of 600,000 tons of coal was wet-washed, and 655,000 tons was cleaned using pneumatic methods. This represented only 19 percent of the coal production being mechanically cleaned.

Production of clays was 23 percent less than in 1960 and was only 3 percent higher than the low recorded in 1958. Despite the decline, Clearfield remained a leading clay-producing county. Eighteen companies reported clay-mining activities. Fifteen produced only fire clay; two produced both fire clay and miscellaneous clay; the other produced only miscellaneous clay. A total of 32 mining operations were reported; 5 were underground, and 27 were open-pit mines. Seven companies sold their entire production of fire clay to manufacturers of refractory products. Fire clays produced were used primarily for firebrick and block and other refractories; a small quantity was used to produce building brick and vitrified sewer pipe. Output of miscellaneous clay and shale was consumed in the manufacture of vitrified sewer pipe and building brick.

Sand and gravel facilities operated by Clearfield Limestone Corp. were purchased late in October by Fry Coal & Stone Co. The plant remained inactive for the balance of the year.

Clinton.—Bituminous coal was mined from three underground mines and five strip mines, one less underground mine than in 1960. At the strip mines, 13 power shovels, 7 draglines, and 11 bulldozers were used. None of the coal mined underground was mechanically cut or mechanically loaded. Of the total coal output, 47 percent was mechanically cleaned.

Lycoming Silica Sand Co., Salona, crushed and sized limestone for use as concrete aggregate, roadstone, and railroad ballast. Some roadstone was sold to the Pennsylvania Department of Highways.

Miscellaneous clay mined under contract for Mill Hall Clay Products, Inc., Castanea, was used for manufacturing heavy clay products. Union Mining, Inc., used fire clay produced at Avis for the manufacture of high-alumina brick.

Columbia.—Anthracite mined from strip pits, culm banks, river dredging, and underground mines totaled 480,200 tons. Leading producers were Jeddo-Highland Coal Co., Sanchez Construction Co., Reading Anthracite, and Lone Star Coal Co.

Bloomsburg Sand & Gravel Co. produced sand and gravel for use as building material from a pit and fixed plant near Bloomsburg.

Alliance Clay Products Co. recovered miscellaneous clay from property leased from Lloyd E. Eister, Mifflinville. Output was used to produce heavy clay products.

Crawford.—Sand and gravel produced by four operators was sold for use as structural and paving sand and gravel and gravel for fill.

Cumberland.—Locust Point Stone Quarries, Mechanicsburg, produced roadstone and agricultural limestone. Hempt Bros., Inc., Camp

Hill, and Valley Quarries, Inc., Shippensburg, produced crushed limestone for use as road material.

Output of sand and gravel was 17 percent less than in 1960. Sand and gravel was processed at three plants and sold for building and road paving uses.

Cumberland County continued as the leading source of kaolin in the State. Kaolin produced by Philadelphia Clay Co. from an open pit near Mt. Holly Springs was used in the manufacture of white cement. The Penn Products Corp. Black Clay mine was inactive the entire year.

Summit Industries, Inc., produced sericite schist at the Herman mine near Goodyear. The crude material was shipped to the company plant at Aspers, Adams County, for processing.

Dauphin.—Total output of stone was 1,478,000 short tons, a slight increase over that of 1960. Four companies crushed limestone at plants near Steelton, High Spire, Harrisburg, and northwest of Palmyra. Chief uses of the stone were for concrete aggregate, roadstone, and blast-furnace flux. Some of the stone was sold to nearby Government agencies for road construction.

A total of 135,400 tons of anthracite was produced from strip mines, culm banks, underground mines, and river dredging.

Shale produced by Glen-Gery Shale Brick Corp.'s Harrisburg and Middletown Divisions was used for the manufacture of building brick. Miscellaneous clay produced by Bethlehem Limestone Co. at its Steelton quarry was used for making protective covering for pipelines.

Output of sand and grave decreased 23 percent mainly because of the liquidation and dismantling of the Highspire Sand & Gravel Co. Hill Station plant near High Spire. Hydrated lime was produced at the Swatara plant, Annville, by H. E. Millard Lime & Stone Co. and sold for agricultural use.

Delaware.—V. DiFrancesco & Sons, Havertown, and General Crushed Stone Co., Glen Mills, quarried and crushed granite (gneiss) chiefly for use as concrete aggregate and roadstone. Dimension granite was recovered at two quarries near Lima and Swarthmore, solely for use as irregular-shaped construction stone. Media Quarry Co., Media, quarried dimension sandstone for rough construction and rubble.

Perlite Products Corp. expanded perlite at its Primos plant from crude material obtained from Colorado. The expanded material was sold or used chiefly as building plaster aggregate, as a mix with asphalt for insulating material, and as concrete aggregate.

Sinclair Refining Co. produced liquid sulfur as a byproduct in the liquid purification of oil refiinery gas by the Claus-type process at its Marcus Hook refinery. Sun Oil Co. produced sulfur as a byproduct from the single stage catalytic oxidation of hydrogen sulphide.

Elk.—Bituminous coal was produced at 15 underground mines (16 in 1960), 8 strip mines (10 in 1960), and 1 auger mine. Most of the coal was produced from the strip mines. At the strip mines, 15 power shovels, 5 draglines, and 12 bulldozers were used. Of the coal mined underground, 81 percent was mechanically loaded using 19 loading machines. Only a small percent of the county production was mechanically cleaned, using wet washing methods.

Fire clay produced was used to manufacture firebrick and block and vitrified sewer pipe. Stone Haven Mix, operating a portable plant near Johnsonburg, produced paving gravel for use on roads by local and State highway crews. Speer Carbon Co., Inc., Saint Marys, produced manufactured (artificial) graphite and sold it to steel manufacturers, iron and steel foundries, and the electrochemical industry.

Erie.—The combined output of sand and gravel by four companies increased slightly over that of 1960. Processed material was transported to consumers by rail and truck. Reed-sedge and humus peat recovered from a bog near Corry by Corry Peat Products Co., was sold packaged and in bulk.

Fayette.—Twenty-seven underground mines, 10 less than 1960, 21 strip mines, 9 less than in 1960, and 1 auger mine were operated for the production of bituminous coal. At the underground mines, 13 cutting machines and 10 loading machines were used. Twenty-one power shovels, 5 draglines, and 22 bulldozers were used at the strip mines. Coal was mechanically cleaned using both jigs and pneumatic methods.

Fry Coal & Stone Co., Division of Martin Marietta Corp., ground and sized limestone from the Lake Lynn quarry, Lake Lynn, and the Coolspring quarry, Uniontown. The stone was sold for use as concrete aggregate, roadstone, and dust for coal mines and for agricultural purposes. General Refractories Co. produced crushed and ground ganister rock at the Childs Nos. 1 and 2 mines for making silica brick. Connellsville Blue Stone Co. quarried and crushed sandstone (bluestone) near Connellsville, for use as concrete aggregate and roadstone. Dimension sandstone sold or used as rubble for dry wall construction was quarried near Connellsville.

Clay from four open pits—one less than in 1960—totaled 98,000 tons and was 34 percent below the 1960 production. Layton Fire Clay Co. mined miscellaneous clay near Layton. Harbison-Walker Refractories Co. and Kaiser Refractories and Chemicals Division, Kaiser Aluminum and Chemical Corp. both near Ohiopyle, and Robert N. Matthews, Lemont Furnace, mined fire clay for the manufacture of refractories. McClain Sand Co., Inc., shipped prepared sand and gravel by truck, railroad, and waterway. Part of the prepared gravel was used by the Pennsylvania Department of Highways.

Forest.—Tionesta Sand & Gravel, Inc., Tionesta, processed sand and gravel for construction uses.

Franklin.—Six active producers mined limestone from seven quarries near Shippensburg, Williamson, Dry Run, Chambersburg, and Mercersburg. The limestone was used chiefly for concrete aggregate and roadstone. Smaller quantities were sold for use as railroad ballast and for agricultural purposes.

Two companies processed sand for building use. Output increased 13 percent over that of 1960. Quicklime, sold for agricultural purposes, was produced in a coal-fired three-shaft-kiln plant at Mercersburg by Frank L. Heinbaugh.

Fulton.—H. B. Mellot Estate, Inc., produced limestone at the Morton quarry, Big Cove Tannery, and the Charlton quarry, Warfordsburg. The stone was crushed at local plants chiefly for use as concrete aggregate and roadstone; some was used for agricultural purposes. Russell Martz produced crushed limestone at the Martz Draw Kiln near Hustontown, for use in lime manufacture. Quicklime was marketed for agricultural use.

H. B. Mellot Estate, Inc., also produced sand; production dropped sharply in 1961, because of the completion of a large construction project in 1960.

Greene.—Greene continued to be the leading county in output of bituminous coal from underground mines; production totaled 9.5 million tons, compared with 10 million in 1960. Eighteen underground mines were active, one less than in 1960. All but a small fraction of the underground production was cut by 39 cutting machines and loaded mechanically by 149 machines. In addition to the underground mines, four strip mines were active, three more than in 1960. Seventy-two percent of the county production was mechanically cleaned, using wet washing methods.

Greene County Clay Products Co., Inc., mined a small quantity of shale from a bank deposit near Waynesburg for use in the manufacture of building brick.

Huntingdon.—Huntingdon County continued to be the chief source of specialized industrial sands. In addition to blast, molding, and engine sands, a variety of ground sands and sands for other industrial uses was prepared by Pennsylvania Glass Sand Corp. at its Keystone Works near Mapleton Depot.

Bituminous coal was produced at four underground mines and five strip mines. Approximately half of the underground tonnage was cut by machine; none was mechanically loaded. None of the output from the underground mines or the strip mines was mechanically cleaned.

Limestone recovered from the McConnellstown quarry of New Enterprise Stone & Lime Co. was crushed for use as concrete aggregate and roadstone. Warner Co., Bellefonte Division, Union Furnace, quarried and crushed limestone as concrete aggregate, roadstone, railroad ballast, and riprap. North American Refractories produced and crushed ganister rock at its Three Springs quarry and plant for making silica brick. Harbison-Walker Refractories Co. did not operate its Mount Union Quarry during the year. Alexandria Fire Clay Co. sold plastic clay from stock as refractory mortar.

Indiana.—Bituminous coal was produced from 72 underground mines, 2 less than in 1960, 29 strip mines, 1 more than in 1960, and 4 auger mines, the same number as in 1960. At the underground mines, 89 cutting machines and 102 loading machines were used. Approximately 96 percent of the underground production was mechanically loaded, and virtually all underground production was mechanically cut. Fifty-one power shovels, 16 draglines, and 57 bulldozers were used at the strip mines. About 66 percent of the county production was mechanically cleaned using jigs, pneumatic, and other wet washing methods.

Hiram Swank's Sons, Inc., discontinued mining operations at its Swank No. 6 underground clay mine. Plastic fire clay produced by L. H. Foehrenbach at a strip mine near Clymer was sold to Hiram Swank's Sons for the manufacture of refractories.

Jefferson.—Bituminous coal was produced from 32 underground mines, 3 more than in 1960, 29 strip mines, 1 less than in 1960, and 5 auger mines, the same number as in 1960. At the underground mines, 50 cutting machines and 30 loading machines were used; 83 percent of the coal was mechanically loaded. At the strip mines, 62 power shovels, 19 draglines, and 50 bulldozers were operated. Only a small quantity of the coal was mechanically cleaned; most of this was cleaned by pneumatic methods.

Fire clay produced from three underground mines—one each at Brookville, Brockway, and Summerville—and from an open pit near Brockway was used to manufacture firebrick and block, vitrified sewer pipe, building brick, tile, and other heavy clay products. Strishock Coal Co. reported no clay production at its pit near Brockway. Bank run gravel recovered by Brockway Sand & Gravel Co., Brockway, was used by local townships and boroughs for maintaining roads.

Juniata.—W. N. Quigley quarried and crushed limestone near Mifflintown for use as concrete aggregate, roadstone, and agricultural stone. Kaiser Aluminum & Chemical Corp. recovered quartzite and crushed and used it at the Van Dyke plant, Thompsontown, to manufacture silica brick.

Lackawanna.—Output of anthracite declined 37 percent in quantity, but the average value per short ton increased from $9.18 in 1960 to $9.89. Anthracite was mined at underground mines, strip pits, and culm banks. Leading producers were Moffat Coal Co. and Hudson Coal Co.

Keystone Pavement & Construction Co., Inc., used part of its output as a prime contractor and sold building and paving sand and gravel to the Pennsylvania Department of Highways and local consumers. Contractors Sand & Gravel, Inc., supplied the Pennsylvania Department of Highways and contractors with building and paving materials. Scranton Sand & Stone Co. produced sand and gravel for paving use. Stabler Construction Co. quarried and crushed sandstone for road material at the West Mountain quarry near Scranton. Most of the stone was sold to the Pennsylvania Department of Highways for road construction.

Lancaster.—The tonnage and value of crushed and broken limestone increased 13 and 14 percent, respectively; output totaled 2,587,000 short tons. Fourteen companies operated 16 quarries, 1 more than 1960, principally near Talmage, Quarryville, Blue Ball, Gap, Denver, and East Petersburg. Leading producers were D. M. Stoltzfus & Son, Inc., Ivan M. Martin, Inc., and Binkley & Ober, Inc. Most of the crushed stone was sold or used for concrete aggregate and roadstone; smaller quantities were used for agricultural purposes, stone sand and asphalt fill. Much of the stone was sold to the Pennsylvania Department of Highways, local and nearby Government agencies, and the Maryland and Delaware State Highway Departments for road construction.

George F. Pettinos, Inc., produced industrial sand at his Honeybrook plant. Ephrata Sand & Gravel Co., Brownstown, Hempt Bros., Elizabethtown, and Milton Grove Sand, Inc., Milton Grove, produced construction sands.

Whitaker Clay Co. produced only a small quantity of fire clay prior to the sale of its property to Narvon Products, Inc., in July. Glen-Gery Shale Brick Corp. produced shale from two mines at Ephrata and Brickerville, and the Lancaster Brick Co. produced miscellaneous clay at Lancaster for its own use in the manufacture of building brick. Quicklime, for agricultural use, was produced and sold by Amos K. Stoltzfus, Elverson. Mineral specimens and gem-quality stones (fluorite, actionolite, byssolite, and pink dolomite) were collected near Blue Ball and Morgantown.

Lawrence.—Shipments and value of portland and masonry cements increased slightly. Bessemer Cement Co., Division of Diamond Alkali Co., utilized crushed captive cement rock at its Bessemer plant to manufacture Types I–II and III, air-entrained and non-air-entrained portland cement. Masonry cement also was produced. Medusa Portland Cement Co., Wampum, produced mostly general use and moderate heat and high-early-strength portland cements and some masonry cement, using the dry process. Cement rock, limestone, sand, shale, slag, and gypsum were used as raw materials. Shipments of cement were largely in bulk by truck to ready-mixed concrete companies and highway contractors in Pennsylvania and Ohio.

Tonnage and value of limestone decreased 9 and 12 percent, respectively, as compared with 1960; total output was 2,665,000 short tons. Five companies produced crushed limestone and cement rock, mainly for use as blast-furnace flux, concrete aggregate, and roadstone, and in manufacturing cement. The stone was recovered from quarries near Bessemer, Wampum, Hillsville, West Pittsburg, and Mahoning Township. Most of the stone was transported by rail.

Bituminous coal was mined from 1 underground mine, 17 strip mines, and 3 auger mines. Twenty-nine power shovels, 21 draglines, and 26 bulldozers were used at the strip mines. Coal mined underground was mechanically loaded and mechanically cut; however, none of the production from the underground mines, strip mines, or auger mines was mechanically cleaned.

Lawrence County ranked second in total clay production and third in the production of both fire clay and miscellaneous clay. Fire clay mined at open pits near Enon Valley was sold to manufacturers of refractories and heavy clay products. Metropolitan Brick, Inc., produced both fire clay and miscellaneous clay at its Midland quarry. Fenati Brick Co., Inc., and Bessemer Cement Co., Division of Diamond Alkali Co., produced shale for their own use from pits near New Castle and Bessemer, respectively. Fire clay mined and hauled under contract for NATCO Corp. was used at its East Palestine, Ohio, plant.

Construction sand and gravel was processed at two plants near New Castle. Mahoning Valley Sand Co. processed construction sand and gravel and a small quantity of industrial sand at its West Pittsburg plant.

Reed-sedge and humus peat, sold in bulk, was produced by D. M. Boyd near New Wilmington. Humus peat was recovered from bogs in Washington Township by Moore's Humus & Nursery. Zonolite Co. exfoliated crude vermiculite shipped from Montana and South Carolina, at its Ellwood City plant.

Lebanon.—Bethlehem Cornwall Corp., a subsidiary of Bethlehem Steel Co., operated the Cornwell mine 5 miles south of Lebanon to produce magnetite ore. The crude ore was mined by block caving and processed at the company's Lebanon concentrator by flotation, magnetic concentration, and agglomeration, yielding iron ore, gold, silver, copper, cobalt, and pyrite.

Lebanon County was third in lime production. Quicklime and hydrated lime were produced by H. E. Millard Lime & Stone Co. at its Annville plant. Some quicklime was sold for agricultural use, and quicklime and hydrated lime were sold chiefly for construction, metallurgy, water purification, and papermaking.

Four producers crushed and sold or used limestone principally for blast-furnace and open-hearth flux, the manufacture of cement and lime, concrete aggregate, and roadstone. Total output was 1,294,000 short tons, 23 percent less than in 1960. Quarries were operated near Lebanon, Cornwall, and Annville. Forty percent of the stone was shipped by rail.

Output of anthracite by dredging operations exceeded that of 1960. Mineral specimens of magnetite and iron ore were collected near Cornwall.

Lehigh.—Lehigh County was the second largest cement producing county. General use and moderate heat, high-early-strength portland, and masonry cements were produced. Plants were operated near Coplay, Cementon, Fogelsville, and Egypt. Mostly captive cement rock was used as raw material, but limestone, gypsum, clays, sand, iron ore, mill scale, and pyrite cinders, also were consumed in making cement. Most of the material was shipped by railroad, in bulk, intrastate, and to New Jersey and New York.

New Jersey Zinc Co., Friedensville, mined zinc ore at its Friedensville underground mine by the room and pillar method. Zinc concentrate was shipped by truck to the company smelter at Palmerton.

Output of cement rock and limestone was 2,159,000 short tons, 3 percent less than in 1960. The Whitehall Cement Manufacturing Co., Cementon; Coplay Cement Manufacturing Co., Coplay; Giant Portland Cement Co., Egypt; and Lehigh Portland Cement Co., Fogelsville, quarried and crushed cement rock at local plants and utilized the stone for manufacturing cement. Lehigh Stone Co., Ormrod; Eastern Lime Corp., West Coplay; and Roy J. Kern, Guthsville, quarried and crushed limestone for concrete aggregate and roadstone. Some of the stone was sold to nearby Government agencies for road material. Penn Big Bed Slate Co., Inc., produced and processed slate at its No. 2 quarry near Slatedale, chiefly for structural and sanitary uses, blackboards, bulletin boards, and standard roofing slate. Gem-quality specimens of agate, jasper, chalcedony, limonite, and corundum were collected in southeastern Lehigh County. Pennsylvania Perlite Corp., Allentown, expanded perlite shipped from mines in Colorado. The material was marketed mainly as a building plaster aggregate, loose-fill insulation, and concrete aggregate.

Luzerne.—Luzerne County continued to rank second in the production of anthracite. Anthracite production totaled 5,593,000 tons and was slightly less than in 1960. Shipments by truck exceeded rail shipments by more than 3 percent. Anthracite was recovered from underground mines, strip pits, and culm banks. Leading producers were Glen Alden Corp., Number One Contracting Co., Jeddo-Highland Coal Co., and Susquehanna Coal Co.

Plants near Wyoming, Avoca, Hazleton, Forty-Fort, Drums, and Nescopeck processed sand and gravel as building and paving material. Output of sand and gravel decreased 19 percent in 1961; it was the least output since 1955.

Sandstone was produced by four operators of quarries near Sweet Valley, White Haven, Jenkins Township, and Jackson Township; the stone was crushed and sold mostly for use as concrete aggregate and roadstone.

Moss, reed-sedge, and humus peat was recovered from bogs near White Haven by Pennsylvania Peat Moss, Inc. Humus peat was recovered from a bog near White Haven by Blue Ridge Soil Pep Co., Inc.

Hazleton Brick Co., Hazleton, used miscellaneous clay to manufacture building brick.

Lycoming.—Lycoming Silica Sand Co. quarried and crushed limestone at the Lime Bluff quarry, Muncy and the Pine Creek quarry, Jersey Shore, principally for concrete aggregate and roadstone. In addition, crushed limestone for agricultural purposes was produced at the Pine Creek quarry. Susquehanna Quarry Co. operated a quarry and a portable plant near Jersey Shore to produce limestone for road material. Some of the stone was sold to nearby Government agencies for road construction. Callahan & Haines Stone Co., Slate Run, produced dimension sandstone as rubble, irregular-shaped construction stone, and flagging stone. Ground slate was produced by Keystone Filler & Manufacturing Co., Muncy.

The combined production of J. A. Eck & Sons, Inc., and Lycoming Silica Sand Co., both of the Montoursville area, placed Lycoming County third in total sand and gravel output. In addition to the sand and gravel produced for paving and construction needs, sand was utilized as industrial sand.

Two underground mines and three strip mines were operated for the production of bituminous coal. The entire production from the underground mines was produced by hand methods. At the strip mines, three power shovels and two draglines were used. None of the coal produced was mechanically cleaned.

Penn Paint & Filler Co., Antes Fort, and Keystone Filler & Manufacturing Co., Muncy quarried tripoli (rottenstone). After crushing, drying, and pulverizing, the material was marketed for use as an abrasive and filler.

McKean.—Plastic fire clay recovered by Kaul Clay Products Co. near Clermont was used for hot tops for the steel industry. Kness Bros. produced two types of fire clay (plastic and burley) for use in foundries and steel mills. Floor and wall tile and building brick were manufactured from shale produced by Hanley Co. near Lewis Run.

C. L. McGavern, Jr., recovered industrial sand from a pit near Bullismills. Bituminous coal was produced only from strip mines. Two mines were active, using 18 power shovels and 14 draglines. None of the coal produced was mechanically cleaned.

Mercer.—Bituminous coal was produced from 2 underground mines and 11 strip mines. At the strip mines, 18 power shovels and 14 draglines were used. Three cutting machines and one mechanical loading machine were used at the underground mines. None of the coal produced underground or from the strip mines was mechanically cleaned.

Combined output from four plants near Mercer, South Pymatuning Township, Sharon, and Sharpsville increased 27 percent over 1960 and was only slightly below the previous high established in 1958. White Silica Sand Co., Greenville, quarried and crushed sandstone principally for furnace or converter lining, road material, and for use in foundries.

Mifflin.—Bethlehem Limestone Co. operated the Naginey quarry near Milroy and crushed limestone chiefly for use as blast-furnace flux, concrete aggregate, roadstone, and stone sand. Honey Creek Lime Co., Reedsville, and Ehrenzeller Lime Co., McVeytown, produced and crushed limestone for manufacturing cement. Quartzite, crushed and ground for making silica brick, was utilized at the local plant of Haws Refractories Co., Hawstone.

Industrial sand produced by Pennsylvania Glass Sand Corp. at its McVeytown operation was used for glass manufacture, molding, grinding and polishing, engine sand, and miscellaneous industrial uses. In addition to molding and engine sand, Miller Silica Sand Co., Barnham and James R. Klines Sons, Lewistown, processed construction sands. George E. Miller Coal Co., McVeytown, produced sand and gravel for construction needs.

Quicklime for agricultural uses was produced at the seven-draw-kiln plant of Ehrenzeller Lime Co., McVeytown. Honey Creek Lime Co. produced and sold hydrated lime for agricultural use at its continuous hydrator plant near Reedsville.

Monroe.—Hamilton Stone Co., Bossardsville, quarried and crushed limestone for use as concrete aggregate, roadstone, and asphalt fill. Some of the stone was sold to the Pennsylvania Department of Highways for road construction. Universal Atlas Cement Division of United States Steel Corp. produced white clay near Kunkletown for use at its cement plant. Sheesley's Minerals, Inc., Kunkletown and Steward and Clyde White, Stroudsburg, prepared sand and gravel for construction use. Output of sand and gravel continued to decline and reached its lowest level since 1955.

Montgomery.—Production of stone was nearly 4 million short tons. Although tonnage and value declined slightly, Montgomery County remained the second largest stone-producing county. Two quarries operating near Conshohocken and Norristown produced crushed and broken limestone for use as concrete aggregate and roadstone. Captive limestone quarried and crushed near West Conshohocken was used for manufacturing cement. Two quarries and plants near Plymouth Meeting and Bridgeport yielded crushed limestone principally for blast-furnace and open-hearth flux, concrete aggregate, roadstone, lime manufacture, and agricultural purposes. Fifty-eight percent of limestone was transported by truck and the remainder by rail and unspecified means. Montgomery Stone Co., Inc., Montgomeryville, quarried dimension basalt as rough and dressed structural stone and crushed basalt for road material. Basalt quarried near Saratoga and

Perkiomenville (traprock) was crushed and broken for concrete aggregate, roadstone, and railroad ballast. Dimension sandstone, chiefly for use as irregular-shaped stone, was quarried near Norristown and Glenside. Fire Stone Products Co., Glenside, produced dimension quartzite for use as rough architectural block and crushed stone for refractory linings in steel-producing furnaces.

Mignattie Construction Co., Inc., Bethayres, produced mostly crushed granite for use as concrete aggregate and roadstone and a small quantity of dimension granite for rubble and irregular-shaped construction stone. Irregular-shaped dimension stone for building retaining walls was quarried at the Hill Crest quarry near Laverock by Marcolina Bros., Inc.

Allentown Portland Cement Co. produced Types I–II, general use and moderate heat, air-entrained and non-air-entrained portland cements and masonry cement from captive limestone and cement rock at its No. 2 plant at West Conshohocken. Three rotary kilns were operated. Most of the material was shipped by rail, intrastate and to New Jersey, to ready-mixed concrete companies.

Six shaft kilns and three continuous hydrators were operated at the Plymouth Meeting plant of G. & W. H. Corson, Inc., to produce mostly hydrated lime for construction, chemical and industrial uses, and agricultural lime. Some dead-burned dolomite for refractory use also was produced.

Total clay production was virtually the same as in 1960. Although The Keller-Whilldin Pottery Co. North Wales clay pit was idle, the company used clay from stock to manufacture pottery products. Robinson Clay Products Co., Pottstown, produced plastic fire clay and miscellaneous clay for making vitrified sewer pipe. Norristown Brick Co., Norristown, produced miscellaneous clay for making building brick. Philadelphia Brick Co., Trappe, used shale mined under contract to manufacture drain tile and flues.

William Bambi & Sons, Inc., processed building sand and gravel at its plant near Norristown. Zeolite, ankerite, galena, quartz crystals, and copper minerals were collected by hobbyists and for use in making costume jewelry. Crude perlite from mines in Colorado was expanded by The Philip Carey Manufacturing Co., Plymouth Meeting, and Refractory & Insulation Corp., Port Kennedy.

Montour.—Lycoming Silica Sand Co., Milton, quarried and crushed limestone for concrete aggregate, roadstone, and agricultural purposes. Mausdale Quarry Co., Danville, quarried and crushed limestone for use as concrete aggregate and roadstone. Some of the stone was sold to the Pennsylvania Department of Highways and to local municipalities and townships for road construction. A small quantity of sand and gravel was recovered by Thomas Sand & Gravel Co. near Danville.

Northampton.—Northampton County remained the leading cement-producing county. The quantity and value of cement shipments increased 6 and 5 percent, respectively. Nine companies operated 11 plants, manufacturing cement from captive limestone and cement rock and from purchased raw materials, mostly sand, clays, gypsum, and iron ore. General use and moderate heat, and high-early-strength portland cements and masonry cement were produced. Sixty-one percent of the cement was shipped by rail, mostly in bulk, to ready-mixed concrete companies and manufacturers of concrete products. Plant operations were near Nazareth, Bath, Martins Creek, Stockertown, Broadhead, and Northampton. Lehigh Portland Cement Co. reported a general shutdown of its Sandt's Eddy plant, Northampton, and made shipments of portland cement from stock.

Northampton County continued as the leading stone-producing county; output decreased 5 percent in quantity but increased 1 percent, in value, compared with 1960. Eleven firms produced limestone or cement rock from quarries near Nazareth (4), Northampton (2), Martins Creek, Stockertown, Bath, Broadhead, and Bethlehem. Most of the cement rock was utilized at the company plants for manufacturing cement, and as concrete aggregate and roadstone. Smaller quantities were used as stone sand and railroad ballast and for agricultural purposes. Northampton County was again the principal source of slate; production decreased 12 percent in quantity and increased 11 percent in value, compared with 1960. Slate was recovered from nine mines (two less than in 1960), four near Pen Argyl, two near Bangor, and one each near Bath, East Bangor, and Plainfield Township. The processed slate was used chiefly for structural and sanitary ware, blackboards, standard roofing, and flagging.

Sand and gravel production exceeded by 23 percent the previous high established in 1960. Material processed at plants near Portland, Easton, Bangor, and Hellertown was shipped to consumers by truck. A smaller quantity of anthracite was produced.

Northumberland.—Anthracite production decreased 19 percent, compared with 1960, and Northumberland continued to rank third among the anthracite-producing counties. Anthracite was mined from underground mines, strip pits, culm banks, and river dredging. Principal producers were Gap Anthracite Co., Treverton Coal Co., and Sayre Contracting Co.

Two companies near Watsontown used shale to make building brick. Watsontown Minerals Product Co., Watsontown, used shale, mined several years before, as a filler in linoleum. Limestone quarried near Herndon and Sundbury was crushed for use as road material, for agricultural purposes, and for lime manufacture. M. E. Wallace Co., Danville, discontinued sand and gravel production in 1960. Structural and fill sand was prepared by Wilson's Sand Plant, Montandan, in 1961. Quicklime for agricultural purposes was produced and sold by Clyde Starook, Northumberland.

Perry.—Limestone was quarried near Newport by Bradford Hills Quarry, Inc., and crushed for use as concrete aggregate and roadstone. Some of the stone was sold to the Pennsylvania Department of Highways and local townships for road construction.

Philadelphia.—The Liberty Corp. dredged and processed building sand and gravel near Philadelphia. Shipments to consumers were made by barge.

Gulf Oil Corp. recovered sulfur as a byproduct in the liquid purification of oil refinery gas at its Philadelphia plant, using the Claus process. Atlantic Refining Co. recovered hydrogen sulfide by the Girdler system, using diethanolamine and monethanolamine.

Potter.—Dimension sandstone was recovered from four quarries, one each near Roulette, Oswago, and two in Austin. Most of the stone was used as flagging stone and rough construction stone.

Schuylkill.—Schuylkill County ranked first in output of anthracite, producing 39 percent of the State total tonnage and value. Underground mines, strip pits, culm banks, and river dredges were operated during the year. The principal producers were Greenwood Stripping Corp., Reading Anthracite Co., Gilberton Coal Co., and Honeybrook Mines, Inc.

Pennsylvania Aggregates, Inc., Summit Station, sold limestone as road material from stockpile. Huss Contracting Co., Andreas, quarried and crushed limestone for use as concrete aggregate and roadstone. Quartzite, quarried and crushed for use in manufacturing silica brick, was produced at the Andreas quarry, Andreas, by Harbison-Walker Refractories Co.

Refractory Sand Co., Inc., processed fire sand and furnace sand at its Andreas plant. Schuylkill County was the leading miscellaneous clay producing county. A substantial quantity of miscellaneous clay was consumed by Lehigh Materials Co. in its lightweight aggregate plant. Auburn Brick Co. used miscellaneous clay from a pit near Auburn for making building brick. Quartz crystals were collected as mineral specimens.

Snyder.—Production of shale decreased 28 percent from that of 1960. Paxton Brick Co., Paxtonville, and Glen-Gery Shale Brick Corp., Beavertown, produced shale for making building brick.

National Limestone Quarry, Middleburg, quarried and crushed limestone and sold it for use as concrete aggregate, roadstone, and for agricultural purposes. Carton L. Comfort, Mount Pleasant Mills, quarried and crushed limestone for use in manufacturing lime. Quicklime was produced at the company's local six-pot-kiln plant and sold as agricultural lime.

Anthracite production was less than in 1960. Central Builders Supply Co. processed and sold building sand and gravel and paving sand from its plant near Selinsgrove.

Somerset.—Somerset County again had the largest number (100) of underground bituminous coal mines (1 less than in 1960). Underground production totaled 1 million short tons; 61 percent was mechanically loaded using 76 loading machines. Seventy-two power shovels, 36 draglines, and 84 bulldozers were used at the strip mines. Only about 19 percent of the county output was mechanically cleaned, using wet washing and pneumatic methods. One auger mine active in 1960 was not active during 1961.

Fire clay from pits near Berlin, Fort Hill, and Springs and from an underground mine at Hollsopple was used in the manufacture of refractories and heavy clay products. Two underground and one open-pit mines were inactive during the year.

Somerset Limestone Co., Inc., produced and crushed limestone at its Bakersville quarry and plant solely for road material. Keystone Lime Co., Springs, quarried and crushed limestone for use as concrete aggregate, roadstone, and for agricultural purposes. A new producer in the county, Rodamer Concrete Products, Springs, quarried and crushed sandstone for use as concrete aggregate and roadstone. Small quantities of sand for various uses were recovered by Robert D. Shaulis and Boswell Sand Co. both near Boswell.

Sullivan.—Anthracite, the only mineral produced in the county, was mined from one underground mine and one strip mine. The output was transported entirely by truck. Bliss Coal Co. was the principal producer.

Susquehanna.—Dimension sandstone (bluestone) was quarried and used mostly as flagging stone; smaller quantities were used for irregular-shaped rough construction stone and rubble. Seven quarries were operated near Kingsley, Springville, New Milford, and Brooklyn Township. Keelor Supply Co., Inc., quarried and crushed sandstone for road material at Bennett's quarry near Clifford. Most of the stone was sold to the Pennsylvania Department of Highways and nearby boroughs and townships for road construction. Anthracite production increased substantially.

Tioga.—Bituminous coal was produced from two underground mines and six strip mines. Sixteen power shovels, 8 draglines, and 13 bulldozers were used at the strip mines. All of the coal produced underground was mined and loaded by hand methods.

Union.—Crushed limestone, used principally for concrete aggregate and roadstone, was quarried near Winfield and Mifflinburg. The Pennsylvania Department of Highways purchased some of the stone for road construction.

Venango.—Bituminous coal was produced from one underground and five strip mines. Eleven power shovels, 4 draglines, and 13 bulldozers were used at the strip mines. Only one mechanical cutting machine was used underground, and none of the underground production was loaded mechanically. Approximately 80 percent of the coal was mechanically cleaned.

Industrial Silica Division of Pennsylvania Glass Sand Corp. recovered and processed industrial sand at its Venango works. Material recovered by dredge was processed by Oil City Sand & Gravel Co. at its plant near Oil City to supply demand for building and paving sand and gravel. White City Sand & Gravel recovered bank run gravel from a pit near Titusville.

Warren.—General Concrete Products Corp. prepared building and paving sand and gravel obtained from its dredging operation near Star Brick. Nelson and Ellberg, Warren, processed sand and gravel for construction needs. Warren Sand & Gravel Co., Inc., Warren, expected to complete construction of its plant in May or June of 1962.

Washington.—Washington County was second in the production of underground bituminous coal. Twenty-one mines were operated to produce 9.4 million tons. Fifty-three cutting machines and 145 mechanical loading machines were used underground. Virtually all of the coal was mechanically loaded and mechanically cut. Twenty-four strip mines were active, two more than in 1960; they used 34 power shovels, 8 draglines, 3 carryalls, and 30 bulldozers. Most of the coal mined in the county was mechanically cleaned, primarily by jigs and other wet washing methods.

Washington Stone Co., Inc., produced crushed limestone for road material at a quarry and stationary plant near Washington. Fry Coal & Stone Co., Division of Martin Marietta Corp., operated the

Claysville Portable No. 3 quarry and plant near Washington to produce crushed and broken sandstone solely for use as concrete aggregate and roadstone. Donley Brick Co. mined red shale from a pit near Washington for use at its local plant for making building brick. Westmoreland Clay Products Co. was inactive during the year.

Wayne.—W. R. Strong & Son and Paul Thompkins Estate reported output of dimension sandstone principally for use as flagging stone; smaller quantities were used as dressed or cut architectural stone, rubble, and flagging stone. Wayne Crushed Stone, Inc., produced crushed and broken sandstone for concrete aggregate, road material, and riprap at the Damascus quarry and the Lake Ariel quarry and plant.

Wayne County led in peat production. Output increased in tonnage but decreased in value. Wayne Peat Humus Co. recovered humus and moss peat from bogs near Gouldsboro. A small quantity of anthracite was produced and transported to consumers by truck. Willis R. Black continued to supply farmers in the area with building sand and gravel and sand for fill.

Westmoreland.—Bituminous coal was produced from 43 underground mines, 5 less than in 1960, 25 strip mines, 5 more than in 1960, and 2 auger mines, the same number as in 1960. Almost all of the coal mined underground was cut using 59 cutting machines, and mechanically loaded, using 60 loading machines. At the strip mines, 30 power shovels, 5 draglines, 2 carryalls, and 23 bulldozers were used. About 80 percent of the county production was mechanically cleaned using jigs, other wet washing methods, and pneumatic methods.

Limestone was quarried and crushed for road material near Jeannette and Lower Burrell. Ray Branthoover and John C. Beaumont, both near Belle Vernon, quarried dimension sandstone for rubble. Dimension sandstone, solely for use as flagging stone, was quarried at Lynn's Quarry, Belle Vernon. Four producers operated quarries near Greensburg, Baggaley, Ligonier, and Murrysville and produced crushed and broken sandstone used solely for road material.

Wyoming.—Reduced demand for sand and gravel for highway construction was responsible for a sharp decline in production, compared with that of 1960. Wyoming Sand & Stone Co., Falls, processed construction sand and gravel and a small quantity of industrial sand at its Price plant. Construction sand and gravel also was processed by East Falls Sand & Gravel, Falls, and The East Lemon Sand & Gravel Co., East Lemon.

York.—Medusa Portland Cement Co. utilized captive crushed limestone for manufacturing portland cement at its six-rotary-kiln plant at York. Waterproof white and gray portland cements and mortar cement were produced by the dry process. Sixty-three percent of the material was shipped by truck and the remainder by rail, mostly to building material dealers and manufacturers of concrete products.

York County ranked third in value of stone production, with an 11-percent increase in both quantity and value over the corresponding 1960 figures. Limestone was produced at 10 operations, 7 near York and 1 each near Mount Wolf, Wrightsville, and Thomasville. Chief uses of the crushed and broken stone were as concrete aggregate, and roadstone, for cement and lime manufacture, and as blast-furnace and open-hearth flux. Smaller quantities were sold or used for agricultural purposes and as railroad ballast. Fifty-six percent of the stone was transported by truck, and the remainder, by railroad and unspecified means. Crushed and ground slate at the Delta open quarry and plant of The Funkhouser Mills, Division of the Ruberoid Co., was marketed as natural granules and flour. Some of the slate flour was exported to Canada and Puerto Rico.

York County again ranked second in lime production, with a 4-percent increase in both tonnage and value over 1960. Lime, produced in two coal-fired rotary kilns at the J.E. Baker Co. York plant, was sold as deadburned dolomite for refractory material.

Output of sand and gravel continued to decline from the high established in 1959. All the material processed at plants near York, York Haven, and Mount Wolf was delivered to consumers by truck. Miscellaneous clay and shale produced by Medusa Portland Cement Co. and Glen-Gery Shale Brick Corp. near York were used in the manufacture of cement and building brick, respectively. Mica (sericite) schist processed by drying and air separation was sold for use as paint, rubber (mold lubricant), and welding rods. General Mining Associates, Glenville, was the only mica producer in the State. Pennsylvania Perlite Corp., York, expanded crude perlite mined in Colorado.

The Mineral Industry of Puerto Rico, the Panama Canal Zone, the Virgin Islands, and Pacific Island Possessions

The Puerto Rico section of this chapter was prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.

By Clinton Knox,[1] Leovigildo Vazquez,[2] and Roy Y. Ashizawa[3]

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PUERTO RICO

VALUE of mineral production in Puerto Rico reached a record $33.8 million, about 14 percent above that of 1960. Construction materials accounted for over 99 percent of the total—cement, sand and gravel, and stone comprising approximately 50 percent, 30 percent, and 19 percent, respectively.

Continued expansion of Puerto Rico's economy was reflected in an increase in net income in fiscal year 1961 to $1.5 billion, more than 7 percent higher than in 1960.[4] A significant part of the increased income was attributed to the construction industry. Corresponding to the rise in income, employment in the construction industry increased more than 7 percent. The reported value of all construction completed in Puerto Rico during fiscal year 1961 was $254 million. Construction activity of this magnitude vitally affected the domestic mineral industry. Output of all mineral commodities except stone increased in value. Cement shipments increased 16 percent in value and 9 percent in quantity. A 7-percent rise in prices was reported.

Area Redevelopment Administration (ARA), U.S. Department of Commerce, authorized Federal participation up to 71 percent of a $1 million project for preliminary economic development studies of 40 municipalities. These were designated as areas eligible for aid under the ARA program.

Puerto Rico's imports totaled approximately $1 billion, 10 percent more than 1960. Mineral fuels, metals, and other raw and processed mineral products comprised 20 percent of the total value. About 48

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[4] Commonwealth of Puerto Rico, Department of the Treasury. Report on Finances and Economy—1961 Fiscal Year, 22 pp.

TABLE 1.—Mineral production in Puerto Rico [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement......thousand, 376-pound barrels..	5,441	$14,546	5,931	$16,946
Clays......thousand short tons..	160	102	184	112
Lime......do....	1	15	1	15
Sand and gravel......do....	8,996	8,669	11,370	10,385
Stone......do....	4,219	7,661	5,049	7,284
Value of items that cannot be disclosed:				
Certain nonmetals......	....	[2] 74	....	....
Total, Puerto Rico [3]......	....	[2] 29,603	....	33,805

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Revised figure.
[3] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement.

percent of imports of mineral products, mostly metals, was from the United States. Crude and unfinished oil from Venezuela, averaging 87,600 barrels daily for the two Puerto Rican oil refineries, was the largest imported item. Coproducts of these refineries made the Island's petrochemical and other manufacturing industries more self sufficient, as well as supplying asphalt for paving, fuel for making cement, and fuel for expanding industrial and urban power-generating plants.

Puerto Rican cement exports totaled 1,541,857 barrels, 5 percent more than in 1960. About 90 percent was shipped to Miami, Fla.

The U.S. Atomic Energy Commission (AEC), jointly with the Puerto Rico Water Resources Authority, continued construction of the $11 million nuclear power plant near Rincon, Aguadilla District, scheduled for completion in late 1962, and signed two contracts totaling $900,000 for nuclear fuel for its superheater power unit. The Federal Geological Survey conducted airborne radiometric surveys of the Island for AEC in November to determine background radiation norms for the Island before operating the nuclear power plant.

Exploration by Bear Creek Mining Co. continued for the third consecutive year with extensive diamond-core drilling for metallic minerals southeast of Lares. Ponce Mining Co., subsidiary of American Metal Climax, Inc., was organized early in 1961 and began diamond-core drilling on a large metallic mineral prospecting concession held by A. D. Fraser of Jamaica. The property extends 20 miles south from Utuado nearly to Ponce. Detailed geologic mapping and geochemical exploration were conducted for A. D. Fraser on 6 square miles of large metallic mineral concessions in the mountains south of San Juan. Aeromagnetic surveys conducted on other prospecting concessions in east-central Puerto Rico were being evaluated.

Petroleum exploration by Kewanee Inter-American Oil Co. was recessed during 1961. At midyear, a geologic report [5] was published by the Puerto Rico Mining Commission on the fourth unsuccessful test well, drilled to a depth of 6,434 feet in 1960.

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[5] Briggs, R. P., and W. A., Gordon. Oil and Gas Possibilities of Northern Puerto Rico. Puerto Rico Mining Commission, 1961, 40 pp.

The Puerto Rico Economic Development Administration (PREDA) investigated the nitrate and phosphate content of bat guano deposits of Mono Island. Research continued on the possible use of Puerto Rico clays in manufacturing lightweight aggregate. The Federal Geological Survey, working under a cooperative agreement with PREDA, completed geologic mapping of four quadrangles and started mapping three more. During 1961, geologic maps and reports on the Coamo,[6] Juncos,[7] and Salinas [8] quadrangles were published.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Importance of the cement industry to the Puerto Rican mineral industry was illustrated by the fact that shipments of this product in 1961 accounted for 50 percent of the total value of mineral production. Shipments of cement were 5.9 million barrels, a 9-percent increase over 1960. At yearend, the two producers reported their stocks of cement had reached an unprecedented 204,366 barrels. Except for gypsum, imported from Dominican Republic, all raw materials used in Puerto Rican cement were produced from deposits near the plants.

External trade of cement continued to be important to the industry. Exports accounted for 26 percent of total shipments of cement from plants. However, as compared with 41 percent exported in 1957, this indicated less reliance on external markets and increasing domestic consumption of cement. Increasing domestic demand for cement accounted for a rise in imports. Imports of cement to Puerto Rico were 7.3 percent of total domestic shipments in 1961, compared with 3.7 percent in 1958.

TABLE 2.—Portland cement production and shipments

Year	Production (barrels)	Shipments		
		Barrels	Value	
			Total (thousands)	Average per barrel
1952–56 (average)	3,954,351	3,937,849	$11,218	$2.85
1957	5,500,553	5,552,357	17,232	3.10
1958	5,861,862	4,747,976	15,175	3.20
1959	5,324,188	5,392,312	16,982	3.15
1960	5,415,086	5,441,497	14,546	2,67
1961	6,070,140	5,931,420	16,946	2.86

A new rotary kiln, 14 feet in diameter by 465 feet long with a rated annual capacity of 1.5 million barrels, was installed in the Cataño plant of Puerto Rico Cement Corp., San Juan District. The expansion doubled the firm's cement-manufacturing capacity and increased

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[6] Glover, Lynn, 3d. Preliminary Report on the Geology of the Coamo Quadrangle, P. R. Geol. Survey Misc. Geol. Inv. Map I-335, 1961.

[7] Broedel, Carl H. Preliminary geologic Map Showing Iron and Copper Prospects in the Juncos Quadrangle, P. R. Geol. Survey Misc. Geol. Inv. Map I-326, 1961.

[8] Glover, Lynn 3d. Preliminary Geologic Map of the Salinas Quadrangle, P. R. Geol. Survey Misc. Geol. Inv. Map I-337, 1961.

Puerto Rico's annual cement-manufacturing capacity to 7.5 million barrels.

Empresas Ferre', Inc., with controlling interest in both Puerto Rican cement manufacturing corporations, announced the sale of its bulk-cement dock facilities in Puerto Rico and Florida. Included in the transaction was the 10,000 ton SS *Florida State* which was used almost exclusively for transporting cement to Florida.

Clays.—Domestic production adequately supplied the demand for clay used in manufacturing cement. Consumption of clay for this purpose increased 24 percent over 1960. Clay used in making heavy clay products and other ceramics was about 10 percent less than in 1960 and was mined from deposits near Carolina in the San Juan District, principally by Puerto Rico Clay Products Corp. Information on the substantial quantity of clay used for fill and other construction was not available.

Sand and Gravel.—Production of sand and gravel increased 26 percent in quantity and 20 percent in value. The apparent decrease in unit value resulted from using approximately 4.5 million tons of low-value fill sand on Government projects. However, the price of building and paving sand and gravel increased.

Sand and gravel was produced from river valley deposits and beaches in all Senatorial Districts. Two government projects administered by the Puerto Rico Industrial Development Co. and the Port Authority of the Commonwealth were essentially completed in 1961. Gahagan Dredging Co. deepened the harbor of Ponce to 30 feet and used the dredged sand for fill in developing an industrial area on 40 acres of tideland. San Juan Dredging Corp. dredged 1.5 million cubic yards of sand from the harbor of Mayaguez and deposited the material on 32 acres of tideland to develop dockside industrial sites. In October, San Juan Dredging Corp. announced purchase of the $1.5 million Allan-Judith hydraulic dredge, 225 feet long and 40 feet wide, for use on the above project and other planned harbor improvements.

TABLE 3.—Sand and gravel sold or used by producers, by uses

Use	1960		1961	
	Short tons	Value	Short tons	Value
Sand:				
Building	1,708,450	$1,244,587	1,816,327	$2,740,807
Fill	2,795,356	2,040,000	5,007,361	1,270,186
Glass	(1)	(1)	30,016	49,135
Paving	(1)	(1)	1,645,000	1,645,209
Other	1,539,148	1,060,730	68,041	55,020
Total	6,042,954	4,345,317	8,566,745	5,760,357
Gravel:				
Building	1,482,027	2,227,067	1,304,000	2,367,396
Fill	------------	------------	218,017	144,780
Paving	[2] 1,471,019	[2] 2,096,703	985,000	1,811,145
Other	------------	------------	[2] 296,400	[2] 301,330
Total	2,953,046	4,323,770	2,803,417	4,624,651
Grand total	8,996,000	8,669,087	11,370,162	10,385,008

[1] Figure withheld to avoid disclosing individual company confidential data.

[2] Includes gravel used as road base.

Silica sand for cement, glassmaking, and other industrial uses was obtained from inland deposits west of San Juan.

Del Rio Sand and Gravel Corp. began operating a new plant on Rio Grande de Loiza near Trujillo Alto. Daily capacity was 4,800 short tons of processed sand and gravel. In addition, Caribbean Sand and Gravel Co. built a plant on Rio Turabo near Caguas, Guayama District, 20 miles south of metropolitan San Juan.

Stone.—There was a 20-percent increase in volume of stone produced. An apparent 5-percent decline in value was largely the result of statistical adjustment of the unit value of limestone used for cement. The increase in the quantity of stone produced was attributed to greater use of limestone in making cement and miscellaneous stone for use by the construction industry. Price rises were noted in some areas. Prices remained relatively high for decorative dimension stone and processed limestone. Improved and expanded highway facilities near metropolitan areas resulted in lower crushed stone prices.

TABLE 4.—Stone sold or used by producers in Puerto Rico

Year	Dimension limestone		Crushed limestone [1]		Miscellaneous stone [2]		Total	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1952-56 (average)	58,274	$120	1,315,296	$1,971	24,744	$43	1,398,314	$2,134
1957	178,619	356	2,225,139	3,085	48,261	64	2,452,019	3,505
1958	148,146	281	1,777,656	2,352	60,000	135	1,985,802	2,768
1959	10,322	23	1,980,840	2,693	72,000	162	2,063,162	2,878
1960	36,941	87	3,474,462	5,938	708,080	1,636	4,219,483	7,661
1961	[3] 77,133	213	3,718,011	4,546	1,253,524	2,525	5,048,668	7,284

[1] Includes limestone for cement and lime.
[2] Includes granite, andesite, and tuffaceous siltstone.
[3] Includes dimension marble.

Limestone, classified as marble in many deposits, was produced in all seven districts of the Island. Andesite, tuffaceous siltstone, and miscellaneous volcanic stone were produced in all but Arecibo District. Granite was produced in Humacao District; basalt, in Mayaguez District. Stone output was 74 percent crushed limestone, 2 percent crushed granite, and 22 percent crushed miscellaneous stone. The remaining 2 percent consisted of rough dimension stone and decorative siltstone. The two cement corporations affiliated with Empresas Ferre', Inc., reported the largest crushed limestone output, totaling about 1.8 million tons. The limestone was used in manufacturing cement.

Located 2 miles south of Trujillo Alto, Cantera Diaz, Inc., a unit of Empresas Diaz, Inc., developed and equipped the largest quarrying and crushing operations on the Island. Rated daily capacity was about 1,500 short tons of volcanic rock.

Puerto Rico Marble Industries, Inc., built a new stone cutting and polishing plant near Hato Tejas, the locality of several marble processing and terrazzo tile manufacturing plants.

MINERAL FUELS

A $3 million expansion program of the Cataño plant of the Carribean Refining Co., San Juan District, increased its daily capacity for refining imported crude oil to 25,000 barrels or about 30 percent over 1960. Commonwealth Oil Refining Co. suspended plans to construct a $6.5 million napthalene plant at its Guaynilla refinery on the south coast of Ponce. This action resulted from cancellation by Stephan Chemical Co., Illinois, of contracts to build a $7 million phthalic anhydride plant in Puerto Rico. Union Carbide Caribe, Inc., indefinitely suspended construction of a $30 million polyethylene plastic plant adjacent to its operating ethylene glycol plant at Penuelas.

The Puerto Rico Water Resources Authority announced that an additional three units with a total capacity of 82,500 kwh would be placed in operation in January 1962 at the thermoelectric plant near Guaynilla. This plant was fueled by residual pitch from Commonwealth Oil Refining Co.

Shell Company of Puerto Rico, Ltd., acquired control of the asphalt, adhesive, and paint manufacturing plant of Placco Puerto Rico, Inc., and the roofing factory of Felco Puerto Rico Co. Both these plants used byproduct asphalt from local refineries.

METALS

Siderurgica Industrial, Inc., Puerto Rico's only steel mill, produced reinforcing bars from domestic and imported scrap and completed an expansion of facilities, increasing capacity to 65,000 tons a year. Information was not available on the progress of a proposed steel mill in Bayamon, San Juan District.

TABLE 5.—Value of mineral production in Puerto Rico, by districts

District	1960 [1]	1961	Minerals produced in 1961 in order of value
Aguadilla	$1,086,976	$1,339,610	Stone, sand and gravel.
Arecibo	800,161	1,055,729	Do.
Guayama	1,287,703	1,496,490	Sand and gravel, stone.
Humacao	878,104	729,684	Stone, sand and gravel.
Mayaquez	3,474,879	2,750,401	Sand and gravel, stone, lime.
Ponce	12,134,501	11,806,386	Cement, sand and gravel, stone, clays.
San Juan	9,941,279	14,626,883	Do.
Total	29,603,000	33,805,000	

[1] Revised figures.

PANAMA CANAL ZONE [9]

Value and quantity of mineral production in the Panama Canal Zone declined 8 percent as compared with 1960. Reduced stone production offset a slight gain in sand and gravel production.

VIRGIN ISLANDS [10]

Basalt production in the Virgin Islands increased 36 percent in quantity and 47 percent in value as compared with 1960.

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[9] Prepared by Clinton Knox.

[10] Prepared by Clinton Knox.

Vitally important to the Islands was development of the first underground fresh-water supply in shallow test wells on St. Croix Island. Expected daily yield was about 250,000 gallons—currently adequate to replace importation of water from Puerto Rico.

TABLE 6.—Mineral production in the Panama Canal Zone and Virgin Islands [1]

Mineral	1960		1961	
	Short tons	Value	Short tons	Value
Canal Zone:				
Sand and gravel	65,000	$68,149	75,204	$73,274
Stone [2]	203,355	305,914	162,704	270,880
Total		374,063		344,154
Virgin Islands: Stone (basalt)	14,895	51,287	20,302	75,399

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Includes basalt.

TABLE 7.—Sand and gravel sold or used by producers in the Panama Canal Zone

Year	Short tons	Value
1952–56 (average)	43,704	$48,880
1957		
1958	41,006	34,616
1959	14,392	20,500
1960	65,000	68,149
1961	75,204	73,274

The $2.5 million sea-water conversion and electric turbogenerating plant constructed on St. Thomas Island under a U.S. Department of the Interior contract, was completed late in 1961. The plant was designed to generate 3,105 kw of electric power and produce 275,000 gallons of potable water daily, at a cost of about $1.25 per thousand gallons.

TABLE 8.—Crushed basalt and miscellaneous stone sold or used by producers in the Panama Canal Zone

Year	Short tons	Value
1952–56 (average)	158,418	$219,590
1957	59,407	98,897
1958	140,464	236,848
1959	223,348	270,085
1960	203,355	305,914
1961	161,451	269,412

TABLE 9.—Crushed basalt sold or used by producers in the Virgin Islands

Year	Short tons	Value
1952–56 (average)	[1] 6,199	$23,204
1957	11,500	31,000
1958	25,296	80,586
1959	14,429	50,616
1960	14,895	51,287
1961	20,302	75,399

[1] Includes miscellaneous stone.

PACIFIC ISLAND POSSESSIONS[11]

REVIEW BY ISLANDS

American Samoa.—Public works crews of the Government of American Samoa were actively engaged in quarrying and processing basalt rock and coral limestone, required in the base course of a new jet runway and taxiway at the Tafuna Airport and for construction of roads and buildings. Part of the year's mineral output also was used in constructing facilities for the international South Pacific Commission conference scheduled to be held in July 1962.

Guam.—Government crews and contractors and commercial producers used quarried coral limestone and coral beach sand for building construction and for surfacing airfields, roads, and parking areas. Dimension coral stone was used for rehabilitating the Apra Harbor area during 1961.

Johnston.—Coral limestone and coral sand were produced and prepared by a government contractor for use as concrete aggregate in constructing communication facilities.

TABLE 10.—Mineral production in the Pacific Islands possessions

Area and mineral	1960		1961	
	Short tons	Value	Short tons	Value
American Samoa: Stone (crushed)	523,161	$260,798	361,514	$286,151
Guam:				
Sand	965	965	38,756	49,369
Stone (crushed)	961,818	2,193,557	292,231	591,303
Total		2,194,522		640,672
Johnston:				
Sand	1,300	3,800	540	1,200
Stone (crushed)	1,500	5,000	675	1,500
Total		8,800		2,700
Midway: Stone (crushed)			10,902	33,544
Wake: Stone (crushed)	36,200	48,870	23,830	62,338

Midway.—Government construction crews and contractors quarried and processed coral limestone and coral fines for use as base course and in asphaltic- and portland-cement concrete aggregate for paving projects and building of communication facilities.

Wake.—Coral limestone quarried by contractors for the Federal Aviation Agency and Military Air Transport Service was used for road stone and concrete aggregate in constructing a new airport terminal and living quarters.

Other Pacific Island Possessions.—No mineral production was reported for 1961 on the Islands of Canton, Enderbury, Jarvis, and Palmyra.

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[11] Prepared by Roy Y. Ashizawa.

The Mineral Industry of Rhode Island

By Joseph Krickich [1]

OUTPUT of minerals in Rhode Island in 1961 totaled $3.1 million. Although this amount was 46 percent below the record year 1960, it was the second highest year on record, exceeding 1959 by 32 percent. The lower level of mineral production was attributed primarily to slackened demand for riprap stone used for constructing breakwater facilities at Newport. The year was highlighted by increased output and value of sand and gravel. Providence and Kent Counties were the leading mineral-producing areas.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Two bulk cement distribution terminals were constructed in Providence County during the year. Cement produced in New York was to be transported to Providence for redistribution.

Gem Stones.—Quarries and old mine dumps attracted gem and mineral specimen collectors. Various mineral specimens were recovered from unspecified localities.

TABLE 1.—Value of mineral production in Rhode Island, by counties [1]

(Thousands)

County	1960	1961	Minerals produced in 1961 in order of value
Bristol	----------	(1)	Sand and gravel.
Kent	(1)	(1)	Do.
Newport	$3,528	$556	Stone, sand and gravel.
Providence	1,445	1,226	Do.
Washington	(1)	361	Sand and gravel, stone.
Undistributed	754	[2] 936	
Total	5,727	3,079	

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes value of gem stones not specified by counties.

Sand and Gravel.—Production of sand and gravel increased 12 percent in quantity compared with 1960 and totaled 1.7 million tons. The increase was due mainly to increased output of paving material by commercial operations. In addition, output by Government-and-contractor operations increased from 19,000 tons in 1960 to 40,000 tons. Building sand and gravel accounted for 43 percent of the State output compared with 45 percent in 1960. Paving materials furnished 28 per-

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[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.

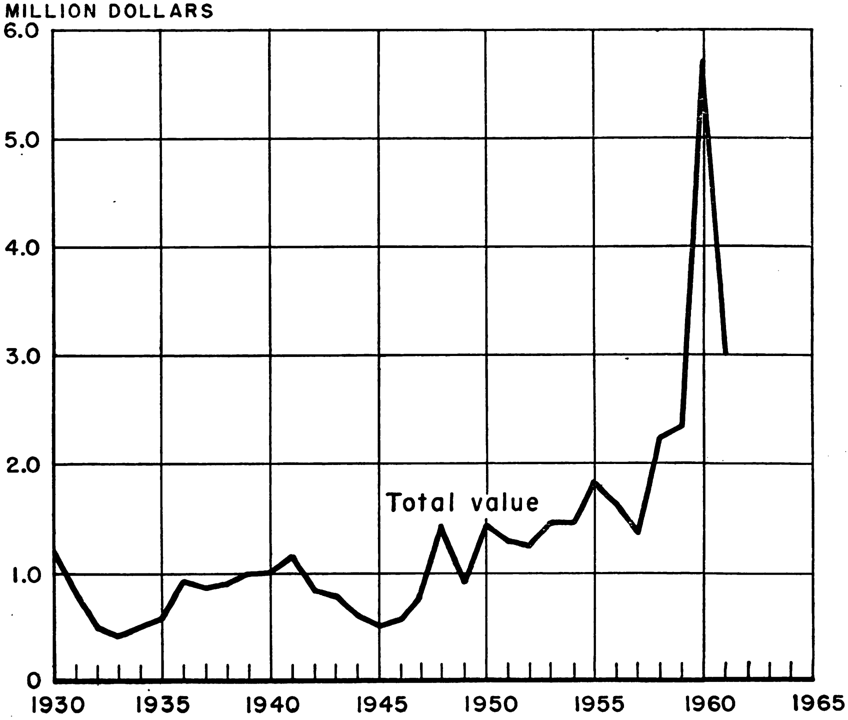

FIGURE 1.—Value of mineral production in Rhode Island, 1930–61.

cent of the total output. Quantities of sand as fill, molding sand, and sand and gravel for miscellaneous uses also were produced. Of the State's total output, 74 percent was processed material, compared with 78 percent in 1960. The average value per ton of commercial sand and gravel increased from 89 cents in 1960 to 97 cents in 1961. The number of commercial producers decreased from 26 to 24; 2 had portable operations. Most of the sand and gravel was transported by truck; less than 1 percent was shipped by rail. An average of 131 employees (including officeworkers) worked daily for a total of 227,000 man-hours. Eight lost-time injuries were reported. Commercial plants produced an average of 59.6 tons per man-shift compared with 51 tons in 1960.

Stone.—Output of stone dropped sharply compared with the record year 1960, when 1.8 million tons of stone valued at $4.4 million was produced. Production decreased because of slackened demand for granite riprap used for constructing a breakwater on a Government project in Newport County. Although demand for granite declined, the quantity and value of limestone and miscellaneous stone output increased. Limestone, used mainly as agstone and roofing gravel, was produced in Providence County. Miscellaneous stone was quarried in Providence and Newport Counties and was used exclusively as concrete aggregate and roadstone. Production of crushed granite in Providence County dropped sharply compared with 1960.

In Washington County the quantity of dimension granite for construction and monumental purposes was below 1960; however, output of crushed and broken granite increased. A stone fabricating yard in Providence County processed dimension granite quarried in Massachusetts and other States. An average of 74 production employees worked 131,000 man-hours at the State's seven stone quarries. Two lost-time injuries were reported for the year.

METALS

Basic steel was produced at four open-hearth furnaces at the Philipsdale plant of Washburn Wire Co. The plant consumed pig iron, scrap iron and steel, ferroalloys, and other raw materials and had a rated annual capacity of 93,000 tons of steel ingots. Two steel-rolling mills were active at Pawtucket with a combined capacity of 32,000 tons of cold-rolled strip steel. Nonferrous scrap was melted and refined at a plant near Providence for the production of pig lead, solder, babbitts, and caulking leads. Numerous foundries throughout the State produced aluminum, brass, bronze, gray iron, malleable, and other castings.

REVIEW BY COUNTIES

Sand and gravel was produced under contract for the State of Rhode Island, Division of Roads and Bridges, Department of Public Works, in Kent and Providence Counties. Output totaled 40,000 tons and consisted entirely of processed paving sand and gravel.

Bristol.—Building and paving sand and gravel as well as fill gravel was recovered at a pit near Barrington by L. Romano Construction Co. The material was trucked to the company's East Providence, Providence County, plant for processing.

Kent.—Kent County ranked second among the State's five mineral-producing areas and led in sand and gravel production. Output of sand and gravel, used mostly for building and paving purposes, increased 8 percent. The county continued to supply over one-third of the State's output. Four commercial producers were active during the year. Molding sand was produced by Rhode Island Sand and Gravel Co., Inc., Warwick, and Whitehead Brothers Co., Washington. Luigi Vallone, Inc., Warwick, and Barber Sand and Gravel, Coventry, also were active.

Newport.—The recently developed granite quarry of M. A. Gammino Construction Co. at Tiverton continued operations, but output dropped sharply as construction of a breakwater for the U.S. Naval Base at Newport neared completion. Production of random and select riprap decreased from 1.4 million tons in 1960 to 210,000 tons in 1961. The stone was loaded from a newly constructed dock onto a specially designed scow that transported the material to the construction site. Conglomerate stone and paving sand and gravel were recovered near Middletown by Peckham Bros. Co., Inc. The stone was crushed for use as concrete aggregate and roadstone.

Providence.—Miscellaneous stone was quarried at Cranston by M. A. Gammino Construction Co. The stone was crushed and processed by wet washing for use exclusively as concrete aggregate and roadstone.

Conklin Limestone Co., Inc., produced dimension and crush limestone at Lincoln. The dimension stone was used as rubble; the crushed stone was used as agstone, roofing gravel, blast-furnace flux, fertilizer filler, and cast-stone aggregate. The Berkeley granite quarry of Fanning and Doorley Construction Co., Inc., was idle; however, shipments of crushed stone were made from stockpiled material. The quarry was not expected to be in operation in 1962. Providence Granite Co. processed and fabricated building and architectural granite and granite for curbing at its yard in Providence. The company used granite quarried in Massachusetts by a subsidiary company as well as stone shipped from other States and foreign countries.

Commercial production of sand and gravel declined 33 percent compared with 1960; Government-and-contractor output decreased 39 percent. Seventy-eight percent of the commercial sand and gravel was washed, screened or otherwise prepared, compared with 81 percent the previous year. All of the Government-and-contractor material was processed. All of the output was shipped by truck and most of it was used for highway building and maintenance and in construction of buildings. Some sand for foundry use, ice control, and for manufacturing masonry blocks also was produced. Principal producers were A. Cardi Construction Co., Inc., and Del Bonis Sand and Gravel Co., both of Cranston; L. Romano Construction Co., East Providence; Foster Sand and Gravel Co., Inc., Foster; Cormier Sand and Gravel, Inc., Lincoln; Joseph Santoro, Inc., Johnston; Valley Cement Block Co., Providence; Tasco Sand and Gravel Co., Smithfield; and Town Line Sand and Gravel, Slatersville.

Lehigh Portland Cement Co. and Marquette Cement Mfg. Co. constructed bulk cement distribution terminals at Providence. The Lehigh terminal began operation in December. Cement was transported from the company's Alsen, N.Y. plant by a specially designed barge with self-unloading equipment. Marquette Cement Mfg. Co. was to ship cement to the Providence terminal (capacity 60,000 barrels) from its Catskill plant at Alsen, N.Y.

Mobil Oil Co. refined crude petroleum at East Providence. As of January 1, the capacity of the skimming and asphalt plant was 11,200 barrels per day. The refinery of Texaco, Inc., at Providence was shut down. Capacity of the Texaco plant was rated at 3,500 barrels per day.

Washington.—Compared with 1960, production of sand and gravel more than doubled. Output was used primarily in road construction and maintenance and consisted chiefly of processed material. Principal producers were J. Romanella and Sons, Westerly; South County Sand and Gravel Co., Washington; and Louis B. Schaeffer, Peace Dale. Granite for rough construction work and monumental purposes was quarried at Bradford by Westerly Granite Corp. The company also supplied riprap to Turner and Breivogel, Inc., marine contractors, of Falmouth Heights, Mass., for construction of seawalls. Gencarelli, Inc., Westerly, began production of granite riprap for use in constructing a seawall at Point Judith for the U.S. Army, Corps of Engineers. Over 100,000 tons of riprap was to be produced for the project over the next 2 years. The Hopkinton granite quarry of Oscar Larson did not operate during the year.

The Mineral Industry of South Carolina

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the South Carolina Geological Survey.

By Robert C. Hickman,[1] Lawrence E. Shirley,[1] and Henry S. Johnson, Jr.[2]

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RECORD production of clays, masonry cement, and crushed sandstone (quartz) were the high points in the mineral industry of South Carolina in 1961. Total mineral output in the State was approximately the same as in 1960, and total value increased $135,000. Leading commodities in order of total value were cement (masonry and portland), crushed granite, clays (kaolin and miscellaneous), sand and gravel, crushed limestone, and vermiculite. These six commodities accounted for 94 percent of the total value of the mineral production.

TABLE 1.—Mineral production in South Carolina [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	1,297	$6,201	1,346	$6,168
Mica (sheet) pounds	101	1	12	(2)
Sand and gravel thousand short tons	3,029	3,048	2,904	3,067
Stone do	7,327	10,593	6,752	9,827
Value of items that cannot be disclosed: Barite, cement, feldspar, kyanite, scrap mica, peat, pyrites, and vermiculite		11,145		12,311
Total South Carolina [3]		30,001		30,136

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Value less than $500.

[3] Total adjusted to eliminate duplicating values of clays and stone.

South Carolina ranked second in the Nation in output of kaolin, kyanite, and vermiculite, and third in crushed granite. Leading companies mining and processing minerals were Carolina Giant Division of Giant Portland Cement Co. (portland and masonry cement, clays, and limestone), Campbell Limestone Co. (crushed granite and limestone), J. M. Huber Corp. (kaolin), Becker County Sand & Gravel Co. (sand and gravel), Zonolite Co. (vermiculite), and Palmetto Quarries Co. (crushed granite).

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] State Geologist, South Carolina Geological Survey, Columbia, S.C.

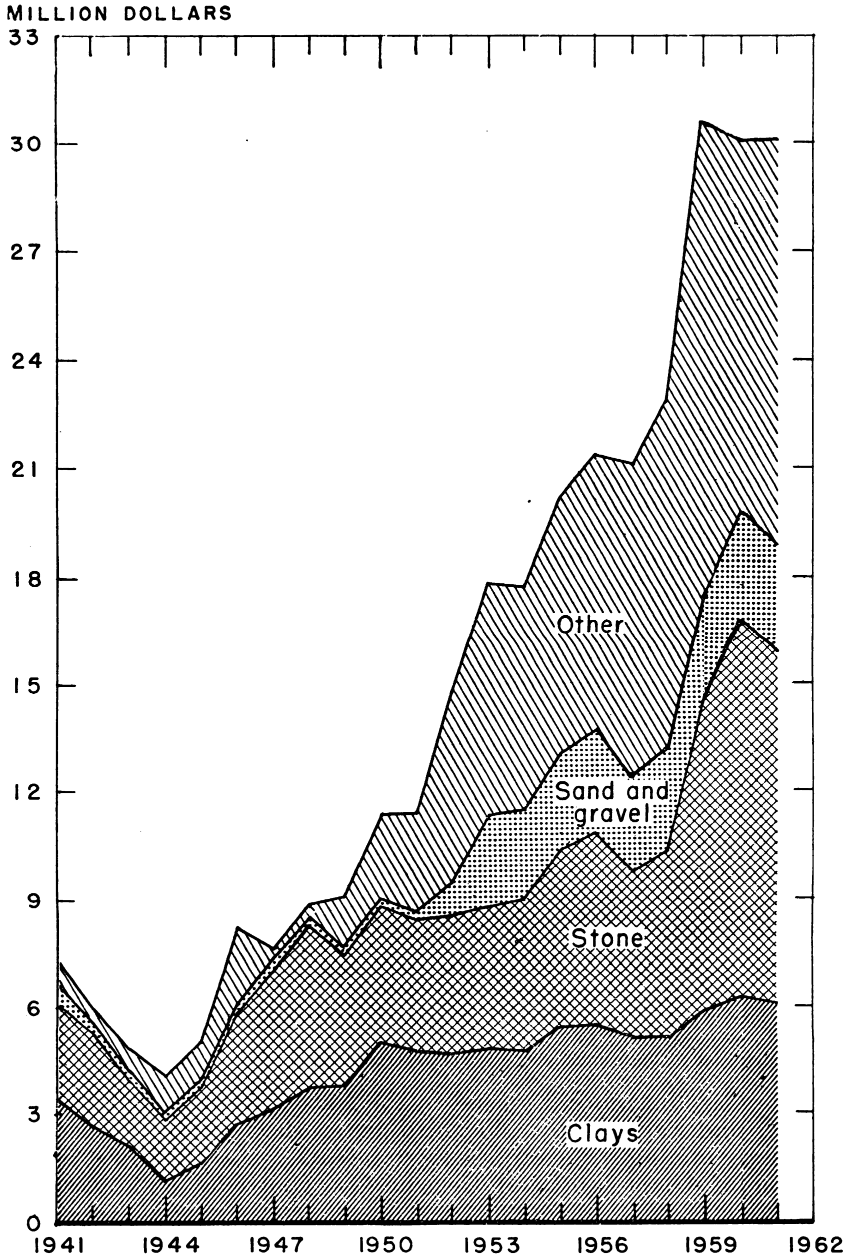

FIGURE 1.—Value of clays, stone, sand and gravel, and total value of minerals produced in South Carolina, 1941–61.

Employment and Injuries.—Reports submitted by producers in the mineral industries indicated that 3 percent less mines, mills, and quarries were active in 1961 than in 1960, and that employment (including officeworkers) increased 18 percent over 1960. Employment increased 21 percent in nonmetal mines and 23 percent in quarries and mills; sand and gravel employment decreased 5 percent. Average active days worked decreased 17 percent in nonmetal mines, 7 percent in quarries and mills, and less than 1 percent in sand and gravel mines. Total man-hours worked in all operations increased 13 percent over 1960.

The overall frequency rate for injuries per million man-hours decreased 44 percent, for all operations, below the frequency rate in 1960; quarries and mills showed the largest decrease, and sand and gravel mines showed a slight increase. Nonfatal injuries decreased 38 percent in all industries combined; nonmetal mines injuries increased by 7, injuries in quarries and mills decreased by 50, and injuries in sand and gravel mines increased by 2 compared with the number of nonfatal injuries recorded in 1960. One fatal accident was reported for 1961, compared with none for 1960.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operations	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960: [1]							
Nonmetal mines	36	997	252	2,149,120	----------	33	15
Quarries and mills	18	766	261	1,600,896	----------	65	41
Sand and gravel mines	32	255	246	501,149	----------	9	18
Total	86	2,018	257	4,251,165	----------	107	25
1961: [2]							
Nonmetal mines	40	1,205	208	2,503,637	----------	40	16
Quarries and mills	21	944	244	1,845,692	----------	15	8
Sand and gravel mines	24	242	245	474,433	1	11	25
Total	85	2,391	252	4,823,762	1	66	14

[1] Excludes officeworkers.
[2] Preliminary figures.

Trends and Developments.—The Division of Geology, State Development Board, started a geochemical prospecting program as part of its mineral resource studies of individual counties. Laboratory work was being done at the Department of Geology, Clemson College. Six county studies were in progress.

South Carolina ports recorded a large increase in volume of world trade handled over 1960, according to the U.S. Department of Commerce. Value of trading through South Carolina ports of entry reached a record of $280 million in 1961. The $36 million increase over the 1960 figure of $244 million worth of world trade was 15 percent and ranked South Carolina sixth in the Nation in rate of increase. Exports increased from $122.5 million in 1960 to $129 million; South Carolina ranked 14th in rate of export increase. Imports rose even more rapidly owing to increased activity in the Southern textile industry. South Carolina ports handled $151 million worth of imports in 1961, a 24 percent increase over $121.6 million in 1960. South Carolina State Ports Authority officials also reported the number of cities in the State which exported goods to overseas markets had risen to 402, an increase of 25 percent over the 1960 total.

Carolinas-Virginia Nuclear Power Associates, Inc., composed of Carolina Power & Light Co., South Carolina Electric & Gas Co., Duke Power Co., and Virginia Electric & Power Co., completed construction of the first nuclear-powered steam generating plant in the Southeast at Parr Shoals, S.C. The heavy-water pressure-tube reactor was expected to go critical in September 1962. Its 17,000-kilowatt output was to be integrated into the system of South Carolina Electric & Gas Co. Enriched uranium, lowered deep into a heavily shielded stainless steel reactor, will supply heat to create steam and turn turbine generators in nearby steam-electric plants.

The South Carolina Electric & Gas Co. budget for 1962 included an initial $3.3 million for construction of a second 137,500-kilowatt steam generating unit at the company's Canadys Station plant near Walterboro, Colleton County.

An experimental machine to purify sea water was in operation at the E. I. du Pont de Nemours Co., Inc. plant near Florence, using salt water hauled from near Charleston by tank truck. The device is a solar still, which uses the sun to evaporate salt water, leaving the salt behind and making pure water available by condensation.

A State highway program costing approximately $53 million was conducted during 1961 by the South Carolina State Highway Department, resulting in the award of contracts for the construction or improvement of 1,162 miles of road and numerous bridges. A somewhat larger program costing an estimated $55 million was planned for 1962.

Contracts awarded to low bidders during 1961 provided for construction of 35 miles on the Interstate system, 233 miles of primary and urban roads, and 890 miles of Federal and State secondary roads. The cost of highway maintenance rose to $16,081,000, compared with $15,486,000 for 1960.

The contracts awarded for 35 miles of new construction during the year were largely in Anderson, Charleston, and Oconee Counties. Several important primary system widening projects were scheduled for 1962, and some urgently needed urban improvements were being planned. Secondary system paving projects were to be continued throughout the State to bring these local facilities to acceptable standards. Greater activity in road construction was reflected in increased use of materials, especially sand and gravel.

The Zonolite Co., producer of vermiculite, was conducting research in masonry construction, including the development of information on making lightweight clay block.[3]

Legislation and Government Programs.—The U.S. Atomic Energy Commission (AEC) was drilling near Aiken in search of deep disposal areas for radioactive materials. One hole already completed was drilled to a depth of 1,900 feet, and drilling of three more holes was in progress. The holes were being drilled to determine the nature of an area of impermeable bedrock underlying the site of the AEC plant near Aiken. High level radioactive wastes from the plant were being stored in large steel and concrete tanks buried underground. If the subterranean bedrock proves suitable for storage, huge underground caverns may be dug. The U.S. Army Corps of Engineers was doing the exploratory drilling, and a total of about 10 holes were to be drilled.

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[3] Robinson, Gilbert C. How To Make Clay Block on Concrete Block Machines. Brick & Clay Record, v. 139, No. 6, December 1961, pp. 43–47.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Industrial Minerals, Inc., Cherokee County, the only barite producer in the State, increased production 7 percent in both quantity and value. The crude barite was ground for use as a rubber filler and shipped out of State. New grinding equipment was installed late in 1960.

Cement.—By value, cement was the second leading commodity in the State. Masonry cement continued to establish record output, with increases made each year since 1957. The 1961 record was 30 percent in quantity and 28 percent in value above the 1960 output. Portland cement increased 13 percent in both quantity and value over 1960. Both types of cement were manufactured by Carolina Giant Division of Giant Portland Cement Co., near Harleyville, Dorchester County. Limestone and clay used in the manufacture of masonry and portland cements increased 18 percent and 15 percent respectively in quantity over 1960. During 1961, Carolina Giant completed an expansion program to increase plant capacity to 4 million barrels of cement annually and established a new sales office in Raleigh, N.C. The construction program, estimated to cost $4 million, entailed the addition of a fourth kiln with an annual capacity of 1.1 million barrels, and additional storage and shipping facilities. The plant had been enlarged twice since it went into operation in 1948.

Clays.—By value, clay was the third leading commodity in the State. New record outputs were established for miscellaneous clay. Total clay output was 1.3 million tons valued at $6.2 million, an increase of 4 percent in tonnage over 1960. South Carolina ranked second in the Nation in production of kaolin. Kaolin production decreased 3 percent in quantity and 4 percent in value to 434,000 tons valued at $5.3 million, and miscellaneous clay increased 7 percent in quantity to 912,000 tons and 24 percent in value to $868,000. Kaolin, used in rubber, insecticides and fungicides, and other fillers, and for refractories, pottery, and stoneware, was produced at 16 mines in Aiken and Richland Counties by 12 companies. Miscellaneous clay, used for cement and heavy clay products, including building brick, paving brick, draintile, sewer pipe, and kindred products, was produced at 12 mines in Cherokee, Dorchester, Fairfield, Greenwood, Lexington, Marion, Marlboro, and Richland Counties by 12 companies. J. M. Huber Corp. (three mines), Dixie Clay Co., and National Kaolin Products Co., all of Aiken County, were the leading producers of kaolin for the third consecutive year. The leading producers of miscellaneous clay, also for the third consecutive year, were Carolina Giant (Dorchester County), Columbia Brick & Tile Co. (Richland County), and Southern Brick Co. (Greenwood County).

TABLE 3.—Kaolin sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Rubber	220,846	$2,868,888	$12.99	221,310	$2,828,671	$12.78
Other refractories	38,078	233,806	6.14	36,452	218,289	5.99
Insecticides and fungicides	49,599	651,529	13.14	21,875	276,359	12.63
Firebrick and block	11,191	57,363	5.13	12,362	71,826	5.81
Paint	(1)	(1)	(1)	3,898	54,960	14.10
Plaster and plaster products	2,500	34,200	13.68	(1)	(1)	(1)
Saggers, pins, stilts, and wads	----------	----------	----------	(1)	(1)	(1)
Other uses	[2] 124,406	[2] 1,656,556	[2] 13.32	[3] 137,851	[3] 1,850,404	[3] 13.42
Total	446,620	5,502,342	12.32	433,748	5,300,509	12.22

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other uses."

[2] Includes whiteware, art pottery, fire-clay mortar, paper fillers, paper coating, linoleum and oilcloth paint, fertilizers, other fillers, chemicals, exports, and other uses.

[3] Includes other fillers, linoleum and oilcloth, exports, whiteware, chemicals, paper filling, fertilizers, plaster and plaster products, saggers, pins, stilts, and wads, art pottery, paper coating, fire-clay mortar, and other uses.

A report[4] on the clays of South Carolina was published. Clay resources discussed included kaolin, siliceous shales, fuller's earth, bentonite, and common clays. Laboratory investigations of 42 samples of clays indicated that common clays suitable for use in structural clay products are abundant in the South Carolina coastal plain. A map showing known clay deposits in the area was included in the report.

Feldspar.—Paco Products, Inc., produced feldspar from granite screenings mined by Campbell Limestone Co. at its Pacolet quarry for the third year; quantity and value greatly increased over 1960. The material was ground and shipped out of State for use by the glass industry.

Kyanite.—South Carolina ranked below Virginia, the only other kyanite-producing State. Output increased 1 percent in quantity and 2 percent in value over 1960. Commercialores, Inc., Henry Knob mine, York County, the only producer, mined, processed, and shipped the material to refractories manufacturers; the company conducted extensive research to produce a better refractory material.

Mica.—Sheet mica production dropped to 12 pounds. Mineral Mining Corp., Kershaw, the only scrap producer, recovered scrap mica from an open cut mica schist deposit in Lancaster County; output increased 2 percent in quantity, but value decreased 8 percent below 1960.

Pyrites.—Commercialores, Inc., York County, produced pyrites as a byproduct of milling kyanite and reported production for the second year. Production increased 50 percent in quantity and 32 percent in value.

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[4] Robinson, G. C., B. F. Buie, and H. S. Johnson, Jr. Common Clays of the Coastal Plain of South Carolina, Bull. 25, Division of Geology, State Development Board, 1961, 71 pp.

Sand and Gravel.—By value, sand and gravel was the fourth leading commodity in the State for the second consecutive year. Production decreased 4 percent in quantity and increased 1 percent in value over 1960. Sand and gravel was produced at 33 mines by 24 companies in 21 counties. All operations were commercial except that of the State highway department. The State highway department continued to operate 11 mines in 11 counties, as in 1960. Thirty-seven thousand tons of sand valued at $17,000 was produced, a decrease of 3 percent in quantity, and the value remained the same as in 1960. Leading sand and gravel producers, in order of production, were Becker County Sand & Gravel Co. in Chesterfield, Marlboro, and Sumter Counties; Whitehead Bros. Co. of New York, N.Y. (Lugoff mine) in Kershaw County; and E. P. Pitts Sand Corp. (Pitts mine) in Horry County. Whitehead Bros. Co., which moved into South Carolina in 1959, reported its production was ahead of the rate estimated when operations were first started. Most of the output was foundry sand and shipments were made throughout the Southeast. Perry Minerals Co. of Clearwater, was constructing a $200,000 sand and gravel processing plant on the Greenwood County bank of the Saluda River, near Ware Shoals. The plant was to process river sand for use in sandblasting, highway work, and other types of construction. Pennsylvania Glass Sand Corp. announced that a new $1 million plant would be constructed near Columbia to process South Carolina silica for use in the glass, ceramic, electrical, chemical, metallurgical, and building industries. The Owens-Corning Fiberglas Corporation Aiken plant for making continuous-filament yarn from glass raw materials was described.[5] The facility produced fibers in about eight basic diameters and featured automatic batching and modern regenerative furnaces.

TABLE 4.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Anderson	5,000	$1,650	3,000	$990
Chester	4,111	1,644	1,479	591
Dorchester	20,554	15,225	20,354	15,077
Greenville	79,121	36,370	64,976	32,011
Lancaster	2,000	500	2,270	567
Lexington	520,712	234,253	582,887	266,819
Oconee			6,976	2,302
Spartanburg	2,238	1,119	1,017	508
Union	500	250		
York	800	264	900	297
Undistributed[1]	2,394,170	2,756,346	2,220,057	2,747,824
Total	3,029,206	3,047,621	2,903,916	3,066,986

[1] Includes the following counties for which figures are withheld to avoid disclosing individual company confidential data: Aiken, Beaufort (1960), Charleston, Cherokee, Chesterfield, Edgefield (1960), Florence, Horry, Jasper, Kershaw, Laurens (1960), Marion (1960), Marlboro, Orangeburg, Richland, and Sumter.

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[5] Chopey, N. P. New Plant Features Latest Look in Making Glass Fibers, Process Flowsheet, Chem. Eng., v. 68, No. 10, May 15, 1961, pp. 136–139.

TABLE 5.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Structural sand	1,221,014	$572,300	$0.47	968,385	$469,377	$0.48
Paving sand	379,810	127,156	.33	479,588	168,269	.35
Engine sand	(1)	(1)	(1)	22,752	56,703	2.49
Filtration sand	(1)	(1)	(1)	9,130	24,530	2.69
Structural gravel	(1)	(1)	(1)	926,283	1,641,744	1.77
Other sand and gravel [2]	1,428,382	2,348,165	1.64	497,778	706,363	1.42
Total	3,029,206	3,047,621	1.01	2,903,916	3,066,986	1.06

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other sand and gravel."

[2] Includes glass, molding, fill, blast, fire or furnace, and other sands, and paving, railroad blast, other gravel and uses indicated by footnote 1.

Stone.—By value, stone production led all commodities. A record high was established in 1961 for output of crushed sandstone (quartz), which increased 46 percent in quantity and 33 percent in value over 1960. The quartz was recovered from granite screenings at the Pacolet quarry of Campbell Limestone Co. by Paco Products Co., Pacolet. Total stone output decreased 8 percent in quantity and decreased 7 percent in value from 1960. Crushed limestone decreased 7 percent in both quantity and value, crushed granite decreased 8 percent in quantity and 9 percent in value, and dimension granite decreased 21 percent in quantity and increased 10 percent in value.

South Carolina ranked third in crushed granite production. Crushed granite was produced from 13 quarries in 9 counties by 7 companies, compared with 12 quarries in 8 counties by 6 companies in 1960. The largest granite producers, supplying 85 percent of the tonnage, were Campbell Limestone Co., Greenville, Pickens, and Spartanburg Counties; Palmetto Quarries Co., Fairfield, Greenwood, and Richland Counties; and Weston & Brooker Co., Lexington County.

Dimension granite was quarried by two companies in Fairfield County and one company in Kershaw County. The largest producer was Winnsboro Granite Co., Rion. Tonnage decreased 21 percent and value increased 10 percent compared with 1960. The Division of Geology, State Development Board, examined several potential quarry sites in the Winnsboro area. Campbell Limestone Co. had experimented with drilling blast holes since 1959,[6] and as a result of the experiments converted from churn drilling to rotary percussion down-the-hole drilling. The conversion increased the average penetration from 2.2 to 18.3 feet per hour, and reduced the cost per foot from $2.38 to $1.18.

Vermiculite.—By value, vermiculite was the fifth leading commodity in South Carolina, and for the third consecutive year, the State ranked second in the Nation in crude ore production. Total output decreased 4 percent in quantity and 1 percent in value below 1960.

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[6] Alfred, Robert C. Granite Tests New Drill Rig. Rock Products, March 1961, pp. 81–83.

Zonolite Co. continued to be the principal producer, mining crude ore in Laurens County and processing it at the company's Kearney plant, near Enoree. Zonolite shipped the processed ore to its own exfoliating plant near Travelers Rest and to out-of-State exfoliating plants. Patterson Vermiculite Co. mined crude ore and processed the material at its own plant near Enoree. American Vermiculite Co. mined crude ore in Laurens and Spartanburg Counties and processed the material at its own exfoliating plant in the Enoree area. Most of the material was used as plaster and concrete aggregate, insulating fill, fertilizer conditioner, and floral needs.

TABLE 6.—Crushed granite sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roadstone	5,196,290	$7,277,128	$1.40	4,767,788	$6,895,621	$1.45
Railroad ballast	354,925	476,021	1.34	211,433	258,990	1.22
Other [1]	443,189	425,009	.96	531,838	306,336	.58
Total	5,994,404	8,178,158	1.36	5,511,059	7,460,947	1.35

[1] Includes stone sand, riprap, and other uses.

METALS

Ferroalloys.—Virginia-Carolina Chemical Corp., Charleston County, operated an electric-arc-furnace plant, producing ferrophosphorus. Pittsburgh Metallurgical Co., Inc., Charleston County, operated an electric-arc-furnace near Charleston and produced ferrosilicon, ferrochromium, and ferrochromium silicon.

Manganese.—P. C. E. Explorations, Ltd., of Toronto, Canada, in late 1960 reportedly investigated manganese holdings in South Carolina. Chip samples taken on outcrops and representing widths up to 400 feet assayed from 6 to 20 percent manganese. Three drill holes indicated that manganese oxidation goes below 100 feet and that open pit mining may be possible. Further diamond drilling was being considered to obtain samples for metallurgical testing.

Steel.—Owen Electric Steel Co. announced plans for a new $1.5 million steel mill at Cayce, the first industry of its kind in the State. The company basically will produce steel billets using an electric furnace and roll the billets into finished steel in the rolling mill operation.

Zirconium.—Orefraction Minerals, Inc., Georgetown County, a subsidiary of Metal and Thermit Corp., New York, continued operating its zircon processing plant near Andrews. The company produced granular and dry-milled zircon for the foundry, refractories, ceramic, and glass industries.

MINERAL FUELS

Peat.—Peat production decreased 40 percent in quantity and 46 percent in value compared with 1960. Reed-sedge peat for use as a soil conditioner was produced from a single operation in Colleton County.

Petroleum.—Dixie Pipeline Co., which announced in 1960 that a new liquefied petroleum gas line would be constructed during 1961, indicated that right-of-way acquisition and the general survey were progressing on schedule. Service Pipe Line Co. designed the 1,080-mile system and was supervising construction. The line starts near Mont Belvieu, Tex., crosses Louisiana, Mississippi, Alabama, Georgia, and South Carolina, and terminates near Raleigh, N.C. The pipeline will have 10 pump stations which will provide 65,000 barrels of LP gas per day.

REVIEW BY COUNTIES

Mineral production was recorded in 28 of the 46 counties, 3 counties less than in 1960. Dorchester, Aiken, and Spartanburg Counties furnished 59 percent of the total mineral production value. The leading 10 counties all had output exceeding $1 million and furnished 89 percent of the total; they were Dorchester, Aiken, Spartanburg, Richland, Laurens, Lexington, Pickens, Fairfield, Marlboro, and Greenville Counties. Eighteen counties reported no mineral production.

Aiken.—For the sixth consecutive year, Aiken County was the second most important mineral-producing county. It was again the largest kaolin-producing county; tonnage decreased 3 percent and value decreased 4 percent. Twelve mines operated by six companies produced kaolin for whiteware, art pottery, firebrick and block, saggers, pins, stilts, and wads, other refractories, paper filling, paper coating, rubber, linoleum and oilcloth, paint, fertilizers, insecticides and fungicides, plaster and plaster products, other fillers, chemicals, exports, and miscellaneous uses. The leading producers were J. M. Huber Corp. (Ideal, Barden, Parker, and Paragon mines), Dixie Clay Co. (McNamee mine), and National Kaolin Products Co. (Aiken County mine). Perry Minerals Co., Inc. (Marine Minerals mine) and South Carolina State Highway Department mined sand and gravel for structural, paving, engine, filtration, and other uses.

Anderson.—Interstate Materials Co. crushed granite for concrete and roadstone. The State highway department mined paving sand for its own use.

Charleston.—Sandrying Company (North Charleston mine) and Edisto Sand & Gravel Co. mined sand for structural use and as fertilizer filler. Virginia-Carolina Chemical Corp. produced byproduct gypsum for use in agricultural products.

Cherokee.—Industrial Minerals, Inc. (Kings Creek mine) mined barite; tonnage and value increased 7 percent over 1960, establishing a record year. Campbell Limestone Co. (Blacksburg quarry) crushed limestone for concrete aggregate, roadstone, and agstone. Miscellaneous clay was produced by Broad River Brick Co. and Bennett

Brick & Tile Co. (Kings Mountain mine); tonnage and value more than doubled over 1960. Jobe Sand Co. (Blacksburg mine) and the State highway department mined engine and paving sand.

Chester.—The State highway department mined paving sand.

TABLE 7.—Value of mineral production in South Carolina, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Aiken	([2])	([2])	Kaolin, sand and gravel.
Anderson	$2,669	([2])	Granite, sand and gravel.
Beaufort	([2])	---	
Charleston	([2])	([2])	Sand and gravel.
Cherokee	([2])	$960,143	Limestone, barite, sand and gravel, miscellaneous clay.
Chester	1,644	591	Sand and gravel.
Chesterfield	([2])	([2])	Do.
Colleton	([2])	([2])	Peat.
Dorchester	([2])	([2])	Cement, limestone, miscellaneous clay, sand and gravel.
Edgefield	([2])	([2])	Miscellaneous clay.
Fairfield	([2])	([2])	Granite, miscellaneous clay.
Florence	([2])	([2])	Sand and gravel.
Greenville	([2])	([2])	Granite, sand and gravel, mica.
Greenwood	([2])	([2])	Granite, miscellaneous clay.
Horry	([2])	([2])	Sand and gravel.
Jasper	([2])	([2])	Do.
Kershaw	([2])	([2])	Sand and gravel, granite.
Lancaster	([2])	([2])	Mica, miscellaneous clay, sand and gravel.
Laurens	([2])	([2])	Vermiculite.
Lexington	([2])	([2])	Granite, sand and gravel, miscellaneous clay.
Marion	([2])	([2])	Miscellaneous clay.
Marlboro	([2])	([2])	Sand and gravel, miscellaneous clay.
Newberry	62,978	---	
Oconee	2,681	([2])	Granite, sand and gravel. mica,
Orangeburg	([2])	([2])	Sand and gravel.
Pickens	([2])	([2])	Granite.
Richland	([2])	([2])	Granite, kaolin, miscellaneous clay, sand and gravel.
Spartanburg	2,213,039	1,683,640	Granite, sandstone, feldspar, sand and gravel, vermiculite.
Sumter	([2])	([2])	Sand and gravel, miscellaneous clay.
Union	250	---	
York	([2])	([2])	Kyanite, pyrites, sand and gravel.
Undistributed	[3] 27,717,739	27,491,626	
Total	30,001,000	30,136,000	

[1] The following counties are not listed because no production was reported: Abbeville, Allendale, Bamberg, Barnwell, Berkeley, Calhoun, Clarendon, Darlington, Dillon, Georgetown, Hampton, Lee, McCormick, Saluda, and Williamsburg.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Revised figure.

Chesterfield.—Becker County Sand & Gravel Co. (Cash mine), F. T. Williams Co. (Pageland mine), and the State highway department mined sand and gravel for structural and paving uses.

Colleton.—Ti-Ti Peat Humus Co., Inc., Green Pond, produced peat for use as a soil conditioner; quantity and value decreased 40 and 46 percent, respectively. This was the only mineral production reported in the county and the only peat producer in the State.

Dorchester.—For the sixth consecutive year Dorchester County led in total value of mineral production; total value increased slightly over 1960. Masonry cement had a record year. Carolina Giant Division of Carolina Giant Cement Co. manufactured portland and masonry cements and produced miscellaneous clay and crushed limestone for use in cement. Masonry cement increased 30 percent in quantity and 28 percent in value over 1960. Portland cement output increased 13 percent in both quantity and value over 1960. The company produced miscellaneous clay at its Harleyville mine. Crushed limestone, previously classified as marl, was produced by Carolina Giant near Harleyville; this operation increased output 18 percent in quantity and 10 percent in value over 1960. Volunteer Portland Cement Co., Agstone Division, mined agricultural limestone; output and value were 50 percent above 1960. Salisbury Brick Corp. (Salisbury mine) mined miscellaneous clay for heavy clay products. Murray Mines Division of Murray Mines, Co., Summerville, mined structural sand.

Edgefield.—Merry Bros. Brick & Tile Co. reported production of miscellaneous clay for heavy clay products. This was the only mineral producer in the county.

Fairfield.—Fairfield County ranked eighth in value of mineral production; the county had ranked seventh in 1960. Palmetto Quarries Co. (Blair quarry) and Rion Crushed Stone Co. (Rion quarry) crushed granite for concrete aggregate, roadstone, and screenings. Comolli Granite Co. (Mahogany quarry) and Winnsboro Granite Co. (Winnsboro quarry) quarried dimension granite for the monument industry; output increased slightly. Richland Shale Products Co. (Richtex mine) mined miscellaneous clay and shale for use in its brick and tile plant; output decreased 18 percent in quantity and 34 percent in value.

Florence.—Coastal Sand Co. (Johnsonville mine) produced building, paving, and fill sand; output decreased slightly in quantity and increased slightly in value from 1960. This was the only mineral producer in the county.

Greenville.—Greenville County ranked 10th in value of mineral production. Zupan Sand Co. (Greenville mine), Saluda Sand Co. (Garrison mine), and the State highway department mined building and paving sand; total output and value remained about the same as in 1960. Campbell Limestone Co. (Lakeside quarry) produced granite for riprap, concrete, roadstone, railroad ballast, and stone sand. W. O. Boling (Boling mine) and Marion V. Cantrell (Full Bright mine) mined a small quantity of sheet mica.

Greenwood.—Palmetto Quarries Co. (Stoney Point quarry) crushed granite for use in concrete, roadstone, screenings, and stone sand. Southern Brick Co. (Ninety-six mine) and Angus Brick & Tile Co. mined miscellaneous clay for use in brick and tile.

Horry.—E. P. Pitts Sand Corp. (Pitts mine) produced glass sand for local consumption and out-of-State use. Output increased slightly over 1960.

Jasper.—Deerfield Sand & Mining Co. (Deerfield mine) produced building sand. This was the only mineral producer reporting in the county.

Kershaw.—Whitehead Bros. Co. (Lugoff mine) and Kershaw County Sand Co. (Camden mine) mined building, fill, and molding sand. Kershaw Granite Co., Inc. (Kershaw quarry) and Comolli Granite Co. (Carolina Diamond Grey quarry) quarried dimension granite for the monument industry.

Lancaster.—Mineral Mining Corp. (Kershaw Strip mine) recovered scrap mica from a mica schist deposit. The material was dry-ground and used in the manufacture of paint, plastics, pipeline enamel, welding rods and electrical insulation; tonnage increased slightly over 1960 but value decreased. Ashe Brick Co. (Van Wyck mine) mined 78,000 tons of miscellaneous clay for the manufacture of building brick at its own plant; quantity increased 7 percent with a slight decrease in value. The State highway department mined 2,300 tons of paving sand for use in highways.

Laurens.—Laurens County ranked fifth in value of mineral production, moving up from sixth place in 1960. South Carolina ranked second in the Nation in vermiculite production and most of the material was produced or processed in the Enoree area. Zonolite Co. (Enoree Area mines) mined and processed crude ore at its Kearney plant near Enoree. The processed ore was shipped to Zonolite's exfoliating plant at Travelers Rest and to exfoliating plants in adjoining States. Patterson Vermiculite Co. (Laurens County mine) mined crude ore adjacent to its exfoliating plant near Enoree. American Vermiculite Co. (Donnon mine) mined crude vermiculite, which was exfoliated at its own plant.

Lexington.—Lexington County dropped from fifth to sixth place in value of mineral production. Weston & Brooker Co. (Cayce quarry) crushed granite for use in concrete, roadstone, screenings, railroad ballast, and stone sand. Guignard Brick Co. (Columbia mine) mined miscellaneous clay for use in manufacturing building brick at its own plant; tonnage and value remained at the 1960 level. Capital Sand Co. (Capital mine), Columbia Silica Sand Co. (Edmund mine), Foster Bros. Dixiana Sand Co., and the State highway department mined sand for structural, paving, blast, fire or furnace, engine, filtration, fertilizer filler, and other uses.

Marion.—J. D. Muchison (Pee Dee mine) produced miscellaneous clay for use in the manufacture of building brick.

Marlboro.—Marlboro County for the third consecutive year was the first ranking county in sand and gravel and moved from 10th to 9th place in total value of mineral production. Becker County Sand & Gravel Co. (Marlboro mine), the leading producer of sand and gravel in the State, and Lawrence Stone & Gravel Co. (Blenheim mine) mined building sand and building, railroad ballast, chemical or metallurgical gravel. Palmetto Brick Co. (Irby mine) and Cheraw Brick Works, Inc. (Cheraw mine) mined miscellaneous clay for use in manufacturing building brick.

Oconee.—J. L. Colville Construction Co. (Colville quarry) produced granite for riprap. The State highway department mined paving sand for use in its highway program. Fate Henry (Jamerson mine) mined a small quantity of sheet mica.

Orangeburg.—J. F. Cleckley & Co. (Orangeburg mine) mined paving sand. This was the only mineral producer reporting in the county.

Pickens.—Pickens County ranked seventh in value of mineral production. Campbell Limestone Co. (Beverly quarry), largest crushed granite producer in the State, mined granite for riprap, concrete, roadstone, and screenings.

Richland.—Richland County again ranked fourth in value of mineral production. The county ranked second in refractory kaolin and miscellaneous clay production. Refractory kaolin output showed no change in quantity but an increase of 3 percent in value over 1960. Palmetto Quarries Co. (Columbia quarry) crushed granite for concrete, roadstone, screenings, railroad ballast, and stone sand. Carolina Ceramics, Inc. (Pontiac mine), Columbia Pipe Co. (Ridgewood mine), Eastern Brick & Tile Co. (601 mine), and R. M. Stork Fire Brick Works (Stork mine) produced refractory kaolin for use in the manufacture of firebrick and block, mortar, and other refractories. Columbia Brick & Tile Co. (Columbia mine) mined miscellaneous clay for heavy clay products. Strickland Sand Co. (Columbia mine) and Harrison Sand Corp. mined sand for structural, fill, engine, and fertilizer filler uses.

Spartanburg.—For the fifth consecutive year, Spartanburg County ranked third in value of mineral production; the county led the State in crushed granite output for the third consecutive year. Campbell Limestone Co. (Pacolet and Pelham quarries), Green Construction Co. (Woodruff quarry), and Clement Bros. Construction Co., Inc. (Westview quarry) produced granite for riprap, concrete, roadstone, screenings, and railroad ballast. Zonolite Co. operated an exfoliating plant at Travelers Rest, using vermiculite from the nearby Enoree Area in Laurens County. American Vermiculite Co. (Propst mine) mined crude vermiculite and transported the material by truck to its own exfoliating plant. Paco Products Co. produced quartz, crude feldspar, and ground feldspar from granite screenings at the Campbell Limestone Co. Pacolet quarry; the material was shipped out-of-State and used primarily by the glass industry. The State highway department mined paving sand.

Sumter.—Sumter County was again the third largest sand and gravel producing county. Becker County Sand & Gravel Co. (Camden mine), the largest sand and gravel producer in the State, mined sand and gravel for structural and railroad ballast uses. Eastern Brick & Tile Co. (Wedgefield mine), near Sumter, reported production for the first year; miscellaneous clay was produced and used in the manufacture of building brick.

York.—Commercialores, Inc. (Henry Knob mine), the only kyanite producer in the State, mined kyanite ore and produced kyanite concentrate for use in firebrick and tile. The company, for the second year, also recovered pyrite as a byproduct from its milling of kyanite ore. The State highway department mined paving sand for use in its highway program.

The Mineral Industry of South Dakota

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota State Geological Survey.

By Carl L. Bieniewski [1] and Allen F. Agnew [2]

⁂

THE DOWNWARD trend in the total value of mineral production in South Dakota that started in 1960 continued in 1961. The value of production, $43 million, was 8 percent below that of 1960. One commodity, gold, from the Homestake mine which again was the Nation's leading gold producer, accounted for nearly one-half of the State's mineral value. Sand and gravel, cement, and stone also were

TABLE 1.—Mineral production in South Dakota [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate........short tons, gross weight..	167	$88	238	$130
Clays [2]........................thousand short tons..	202	202	249	249
Coal (lignite)..do....	20	83	18	75
Copper (recoverable content of ores, etc.)...short tons..	1	1	------------	------------
Feldspar..long tons..	45,588	292	29,354	186
Gem stones..	(3)	20	(3)	18
Gold (recoverable content of ores, etc.)...troy ounces..	554,771	19,417	557,855	19,525
Gypsum..........................thousand short tons..	22	89	22	89
Iron ore (usable)....thousand long tons, gross weight..	(4)	(4)	22	100
Lead (recoverable content of ores, etc.).....short tons..	------------	------------	(5)	(6)
Mica: Scrap...do....	205	10	1,054	32
Sheet..pounds..	30,887	145	18,086	37
Petroleum (crude)..........thousand 42-gallon barrels..	281	(4)	[7] 234	(4)
Sand and gravel..................thousand short tons..	13,548	9,359	11,324	7,336
Silver (recoverable content of ores, etc.) thousand troy ounces..	108	98	127	118
Stone............................thousand short tons..	3,149	7,909	2,806	6,642
Uranium ore....................................short tons..	41,104	586	43,588	495
Value of items that cannot be disclosed: Cement, clays (bentonite), lime, lithium minerals (1960), vanadium, and values indicated by footnote 4..................	------------	9,376	------------	8,978
Total South Dakota [8]................................	------------	46,780	------------	42,980

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes bentonite; included with "Value of items that cannot be disclosed."
[3] Weight not recorded.
[4] Figure withheld to avoid disclosing individual company confidential data.
[5] Less than one-half ton.
[6] Less than $500.
[7] Preliminary figure.
Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

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large contributors; however, sand and gravel and stone production fell substantially below their 1960 output. Nonmetals accounted for $21.9 million, or 51 percent, of the total value, metals for $20.5 million, or 48 percent, and fuels for $0.6 million, or 1 percent, compared with the 1960 percentages of 55, 43, and 2 percent, respectively. Lawrence and Pennington Counties, in the western part of the State, produced about three-quarters of the value. Mineral production was reported from 62 of the State's 67 counties.

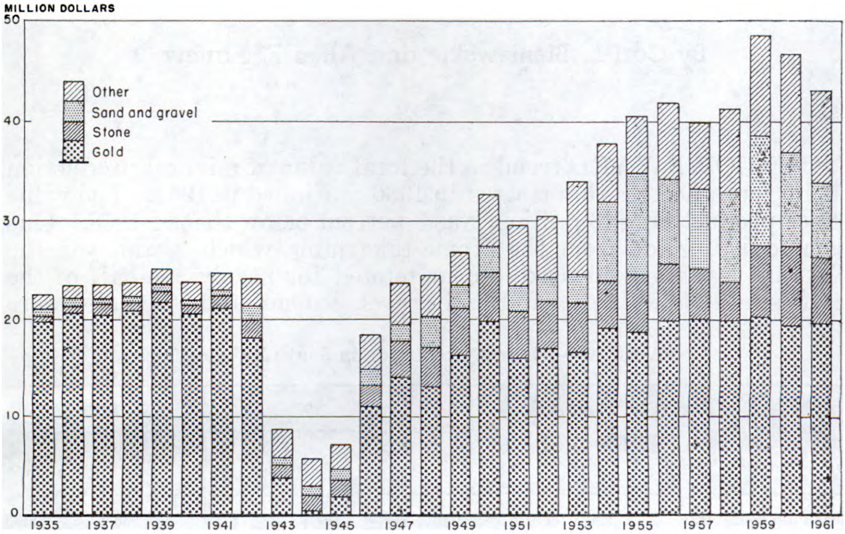

FIGURE 1.—Value of gold, dimension and crushed stone, sand and gravel, and total value of mineral production in South Dakota, 1935–61.

Employment and Injuries.—Final data for 1960 and preliminary data for 1961 compiled by the Bureau of Mines for employment and injuries in the South Dakota mineral industries, excluding the petroleum industry, are shown in table 2.

Government Programs.—The General Services Administration (GSA) continued to purchase domestic mica and beryl throughout the year at the Custer depot. The programs under which these commodities were purchased were scheduled to terminate June 30, 1962. No Office of Mineral Exploration (OME) contracts were issued during the year. The OME contract with the Lithium Corporation of America, signed in 1960, was terminated in June 1961 by mutual agreement. Metallurgical research on South Dakota minerals, conducted by the Federal Bureau of Mines at Rapid City, was transferred to the Bureau's Salt Lake City Metallurgy Research Center. The Office of Saline Waters (OSW) constructed a water desalination plant at Webster capable of converting 250,000 gallons per day of brackish water to fresh water. This was the second plant to be completed of five such plants that were to be built by OSW in the United States.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	Number of operations[2]	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Nonfatal	
1960:						
Metal mines and mills (excluding uranium)	55	1,788	4,299,522	2	68	16.3
Uranium mines and mills	44	123	151,964	----------	5	32.9
Nonmetal mines and mills (other than sand and gravel and stone)	90	209	292,628	1	8	30.8
Stone quarries and plants	90	548	1,205,845	1	20	17.4
Sand and gravel plants	190	1,248	1,718,711	1	35	20.9
Coal mines	1	9	16,000	----------	----------	----------
Total	470	3,925	7,684,670	5	136	18.3
1961:[3]						
Metal mines and mills (excluding uranium)	55	1,831	4,403,145	1	57	13.2
Uranium mines and mills	23	104	204,216	----------	10	49.0
Nonmetal mines and mills (other than sand and gravel and stone)	85	213	304,204	1	5	19.7
Stone quarries and plants	76	556	1,074,406	----------	20	18.6
Sand and gravel plants	209	1,496	1,960,180	----------	12	6.1
Coal mines	2	9	13,442	----------	----------	----------
Total	450	4,209	7,959,593	2	104	13.3

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Preliminary figures.

Construction continued throughout the year at the Pathfinder atomic power plant, a cooperative project of the Atomic Energy Commission (AEC) and Northern States Power Co. The plant, near Sioux Falls, was expected to be completed early in 1962 and, according to AEC, initial criticality of the 62,000-kw reactor should be attained by September 1962.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Cement sales of the State-owned plant at Rapid City, which is the only cement plant in South Dakota, increased 12 percent in quantity and 4 percent in value over that of 1960. Under South Dakota law the money received from cement sales is earmarked for construction and maintenance of State, county, and municipal roads.

Portland cement shipments represented 98 percent and masonry cement shipments 2 percent of the total cement sales. Prices of portland cement averaged $2.91 a barrel (376 pounds), compared with $3.14 in 1960. Masonry cement sold for $3.89 a barrel (376 pounds), the same price as in 1960.

Shipments of portland cement outside of South Dakota were made to Colorado, Iowa, Minnesota, Montana, Nebraska, North Dakota, and Wyoming. Masonry cement was shipped to all these States except Colorado and Iowa. Seventeen new sales outlets were established in Minnesota, Nebraska, and Colorado for selling portland and masonry cements produced at the State-owned cement plant. The South Dakota Cement Commission signed a 1-year option on 160 acres of land outside Wolsey, at the intersection of the Milwaukee and Northwestern railroad lines, for possible development into a cement distribution center for the eastern part of the State.

Clays.—The quantity of miscellaneous clay used during the year increased 23 percent over 1960. About one-half of the clay was used for manufacturing cement at the South Dakota cement plant. Other main uses included lightweight aggregate and building brick. Bentonite production was far below the 1960 figure. Only a small quantity was mined from a State lease in Butte County. The main uses for bentonite were in rotary drilling mud and refractories.

Feldspar.—Quantity and value of crude feldspar output dropped 36 percent below that of 1960. Reduced demand for South Dakota ground feldspar by eastern manufacturers of glass, enamel, insulation, brick, and tile caused the decrease. Increases of ground feldspar used in making pottery and porcelain were not enough to offset the reduction.

Crude feldspar was mined at 56 mines, compared with 72 in 1960. Only potash feldspar was obtained from these operations. Mines producing over 1,000 long tons of crude feldspar were the Abingdon Feldspar mines, Albino No. 1, St. Louis, Shamrock, and Tip Top. Nearly all the mined feldspar was purchased by International Minerals & Chemical Corp. (IMC) for its grinding plant at Custer.

Gem Stones.—The value of gem stones produced decreased 10 percent below that of 1960. Gem stones were reportedly found in sizable quantities in Custer, Fall River, Lawrence, Pennington, and Shannon Counties. Agate, chalcedony, and rose quartz were the leading gem materials.

Gypsum.—Although output from the only gypsum producer, the South Dakota cement plant, was the same as in 1960, the quantity of gypsum consumed increased 30 percent. This resulted in a reduction of the stockpile at the cement plant in Rapid City. Gypsum was used as a portland cement retarder.

Lime.—Quicklime produced by Black Hills Lime Co., at a plant near Pringle, was sold for metallurgical use. Utah-Idaho Sugar Co. produced quicklime at its Belle Fourche sugar plant for use in making sugar.

Lithium.—The Etta mine, the State's principal source of lithium in 1960, was purchased in January 1961 by Corde Clifford from Maywood Chemical Works, Division of Stepan Chemical Co. The mine was inactive during 1961, for the first time in 50 years. A small quantity of lithium, obtained as a byproduct from some pegmatite mining operations, was stockpiled for future sale.

Mica.—Block mica recovered from hand-cobbed mica decreased 77 percent in quantity and 74 percent in value below that of 1960. The hand-cobbed mica was sold to GSA at the Custer purchasing depot. A private contractor processed the hand-cobbed mica and the resulting block mica was placed in Government inventories. Government purchases of domestic mica were scheduled to terminate June 30, 1962.

TABLE 3.—Production of hand-cobbed mica and yield of sheet mica

Year	Hand-cobbed mica	Total block mica recovered		Stained quality recovered		Good-stained and better quality recovered	
	Pounds	Pounds	Percent of hand-cobbed	Pounds	Percent of total block	Pounds	Percent of total block
1957	149,163	9,048	6.07	4,828	53.36	255	2.82
1958	257,198	16,681	6.49	9,552	57.26	471	2.82
1959	365,712	38,734	10.59	20,079	51.84	601	1.55
1960	286,043	30,887	10.80	18,662	60.42	461	1.49
1961	83,381	7,086	8.50	4,994	70.48	214	3.02

One operator sold punch and washer mica to an eastern fabricator of block mica. Scrap mica produced from two mines was sent to grinding plants in California and Illinois. Production of hand-cobbed mica declined sharply, and only 29 percent of the 1960 quantity was obtained in 1961. The number of mines operated continued to decline; only 20 mines were active, compared with 38 in 1960. Leading producers of crude mica were Homestead Mining Co., Michael Kennedy, and Carl Roseberry.

TABLE 4.—Mica sold or used by producers

	1957	1958	1959	1960	1961
Hand-cobbed mica, total: [1] pounds	149,163	257,198	365,712	286,043	83,381
Sheet mica:					
Full-trimmed:					
Pounds	45	94	41	----------	----------
Value	$756	$1,393	$593	----------	----------
Average per pound	$16.80	$14.82	$14.46	----------	----------
Punch and washer: [2]					
Pounds	----------	----------	----------	----------	11,000
Value	----------	----------	----------	----------	$300
Average per pound	----------	----------	----------	----------	$.03
From hand-cobbed mica: [1]					
Pounds	9,048	16,678	38,734	30,887	7,086
Value	$44,751	$66,489	$157,234	$145,154	$37,040
Average per pound	$4.95	$3.99	$4.06	$4.70	$5.23
Total:					
Pounds	9,093	16,772	38,775	30,887	18,086
Value	$45,507	$67,882	$157,827	$145,154	$37,340
Average per pound	$5.00	$4.05	$4.07	$4.70	$2.06
Scrap mica:					
Short tons	1,626	1,003	158	205	1,054
Value	$43,142	$24,241	$4,916	$9,748	$32,122
Average per ton	$26.53	$24.17	$31.11	$47.55	$30.48
Total sheet and scrap mica:					
Short tons	1,631	1,011	177	220	1,063
Value	$88,649	$92,123	$162,743	$154,902	$69,462

[1] Sold to the Government through GSA.
[2] Sold to industry.

Sand and Gravel.—No sand and gravel production was reported for 6 of the 67 counties. Sand and gravel output continued the decline started in 1960. Production was 2.2 million tons, or 16 percent below that of 1960. Road construction in 1961, the largest use for sand and gravel, was considerably less than that of 1960. The U.S. Bureau of Public Roads [3] reported that of the 679 miles of the Interstate highway designated for South Dakota, 168 miles was open to traffic, 254 miles was underway (either in the construction, engineering, or right-of-way phase), and 256 miles was to be started. A total of 52 miles of new road of the Interstate System was opened to traffic in 1961. A comparable figure for 1960 was not available because the Bureau of Public Roads changed its method of reporting progress for the Interstate System in 1960. Under the Federal-Aid Primary and Secondary (ABC) highway system, 669 miles was completed in 1961, and 276 miles was under construction at the end of the year; in 1960 these figures were 1,138 and 445, respectively.

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[3] Bureau of Public Roads, Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1961. Press release BPR 62–4, Feb. 7, 1962.

TABLE 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	572	$689	502	$583
Paving	212	195	255	220
Railroad ballast	(1)	(1)	(1)	(1)
Fill	9	12	13	7
Molding	4	16	(1)	(1)
Blast	---	---	(1)	(1)
Oil (hydrafrac)	3	21	(1)	(1)
Other	71	78	17	53
Total sand	871	1,011	787	863
Construction gravel:				
Building	96	120	109	160
Paving	1,581	947	2,961	1,813
Railroad ballast	176	126	62	59
Fill	34	12	97	49
Other	123	94	20	22
Miscellaneous gravel	418	217	89	74
Total gravel	2,428	1,516	3,338	2,177
Total sand and gravel	3,299	2,527	4,125	3,040
Government-and-contractor operations:				
Sand:				
Building	2	1	125	88
Paving	520	343	594	494
Total sand	522	344	719	582
Gravel:				
Building	132	138	---	---
Paving	9,595	6,350	6,480	3,714
Total gravel	9,727	6,488	6,480	3,714
Total sand and gravel	10,249	6,832	7,199	4,296
All operations:				
Sand	1,393	1,355	1,506	1,445
Gravel	12,155	8,004	9,818	5,891
Grand total	13,548	9,359	11,324	7,336

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

Other substantial consumers of sand and gravel were the Oahe, Fort Randall, and Big Bend dam construction projects and the Intercontinental Ballistics Missile installations (Titan and Minuteman) in the western part of the State. Silica sand, produced by Black Hills Silica

Sand Co. from its operation near Hill City, was used in the hydrafrac process for recovering oil and gas, for foundry moldings, and for sand blasting. Twelve sand and gravel operators produced more than 100,000 tons, each, but none exceeded 500,000 tons. The six leading producers were Western Contracting Corp., Dave Gustafson & Co., Inc., G. H. Lindekugel & Sons, Inc., Highway Construction Co., Concrete Materials Co., and Rounds Construction Co.

Stone.—Overall stone production was 11 percent in quantity and 16 percent in value below that of 1960, mainly because of a decrease of about 200,000 tons of crushed limestone for use in road construction. The principal uses for limestone were road construction and cement manufacture, which accounted for 55 percent and 42 percent of the total limestone production, respectively. Limestone also was used for riprap, railroad ballast, and lime manufacture.

Granite was prepared and marketed as dimension and crushed stone. Dimension granite in rough and dressed blocks was used for architectural and monumental purposes; crushed granite was used for riprap and aggregate. All of the miscellaneous stone produced was used for the Oahe dam project as riprap, spalls, and filter blanket. Crushed sandstone was used as refractory stone, riprap, railroad ballast, filler, roofing and decorative gravel, and base material in road construction. Producers with outputs of crushed stone exceeding 100,000 tons were L. G. Everist, Inc., South Dakota Cement Commission, Concrete Materials Co., Hills Material Co., Spencer Quarries, Inc., Missouri Basin Construction Co., and Pete Lien & Sons.

METALS

Beryllium.—South Dakota was the Nation's leading producer of hand-cobbed beryl. Although only 65 mines operated in 1961, compared with 71 in 1960, the quantity of beryl sold was 43 percent greater. The quantity sold from individual properties, all in Custer or Pennington Counties, ranged from 11 pounds to over 130,000 pounds. The beryllium oxide (BeO) content of the beryl marketed averaged 11.0 percent.

Output of beryl from each of two properties, operated by Hough & Judson, exceeded 100,000 pounds. Before 1961, no single South Dakota property had produced 100,000 pounds in 1 year. Operators who produced and sold more than 10,000 pounds of beryl were Peerless Minerals, Inc., Bland Mining & Milling Co., Walter Clifford, Double R Mines, Fred Tubbs, and Leonard E. Wood. Gladys Wells purchased some beryl for resale to consumers; however, the main outlet was GSA, which bought beryl for the national (strategic) stockpile under the Government purchase program for domestically produced beryl ores. This program was scheduled to terminate June 30, 1962. Research and development for concentrating low-grade beryl ores was conducted throughout the year at the Northwest Defense Minerals, Inc., mill at Keystone.

Gold and Silver.—Gold alone accounted for 45 percent of South Dakota's mineral production value. All recovered gold and virtually all the recovered silver came from the Homestake Mining Co. operation at Lead. The value of the bullion recovered by Homestake was $126,-

000 more than in 1960. According to the company annual report, 1.78 million tons of ore with an average grade of $11.31 per ton was mined and delivered to the mill. This tonnage surpassed the 1960 production of nearly 1.77 million tons, which had been the highest production in the operation's history. The Homestake mine again was the Nation's leading gold producer. The only other production of silver during 1961 was from the Silver Queen mine near Deadwood, operated by Hage Bros., Inc.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)		Total value (thousands)
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)	
1952-56 (average)	4	--------	1,563	531,471	$18,601	142	$129	[3] $18,731
1957	2	--------	1,779	568,130	19,885	135	122	20,007
1958	3	--------	1,824	570,830	19,979	153	138	20,117
1959	2	--------	1,778	577,730	20,221	124	113	20,334
1960	2	--------	1,767	554,771	19,417	108	98	[4] 19,515
1961	2	--------	1,781	557,855	19,525	127	118	[5] 19,643
1876-1961	--------	--------	(6)	28,808,762	789,904	11,645	8,675	[7] 798,744

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore or old tailings shipped directly to smelters during the calendar year indicated.

[2] Does not include gravel washed.

[3] Includes 12 short tons of lead valued at $3,264.

[4] Includes 1 ton of copper valued at $642.

[5] Includes less than one-half ton of lead valued at $52.

[6] Data not available.

[7] Includes 107 short tons of copper valued at $37,108, 497 tons of lead valued at $71,804, and 265 tons of zinc valued at $56,406.

Iron Ore.—Iron ore, mined by Pete Lien & Sons near Rochford in Pennington County, was purchased by the South Dakota Cement Commission under its stockpiling program, for use in manufacturing cement at Rapid City.

Lead.—Hage Bros., Inc., shipped a small quantity of lead-bearing silver ore from the Silver Queen mine near Deadwood to the American Smelting and Refining Co. lead smelter at East Helena, Mont. This was the first year since 1953 that lead was recovered from a South Dakota ore. Activity at the mine consisted of driving exploratory and development drifts.

Uranium ore.—Uranium ore production was 6 percent higher than that of 1960; however, the value was 16 percent lower because the mined ore averaged 0.17 percent U_3O_8 ($11.56 per ton), compared with 0.19 percent U_3O_8 ($14.44) in 1960. Shippers of uranium ore during the year were Black Hills Uranium Co., Walter L. McKenna, Susquehanna-Western, Inc., Chase Mining Co., Bettenhausen & Wheeler, Chord Uranium Co., F. J. & F. Albright, Emmett Isaacs, Giant Cycle Corp., and Rosenland & Cleghorn.

Mines Development, Inc., a subsidiary of Susquehanna-Western, Inc., completed its 5th year of uranium milling at Edgemont. The company and AEC agreed on terms for a new milling contract extending through 1966. Mill capacity was increased as of September 1, 1961, under authorization by AEC pending approval of the new contract, which was still unsigned at yearend.

Vanadium.—The vanadium circuit installed at the Mines Development, Inc., uranium mill in 1960 was operated throughout the year to recover vanadium contained in uranium ores from South Dakota and Wyoming. The South Dakota uranium ores which contained vanadium averaged 0.153 percent V_2O_5 (3.1 pounds vanadium oxide per ton).

MINERAL FUELS

Coal (Lignite).—Output of coal (lignite) declined for the second consecutive year, as production was 10 percent below that of 1960. All production attributed to the State came from a strip mine operated by Dewey County Coal Co. Small quantities (less than 1,000 tons) not included in the State total were mined from properties in Corson, Harding, and Perkins Counties.

Petroleum.—Petroleum (crude) production decreased 47,000 barrels, or 17 percent, below that of 1960, thereby reversing the past upward trend. Except for a small quantity produced by 1 well in the Barker Dome field, the production was obtained from 19 wells in the Buffalo field.

According to State reports, the four exploratory wells drilled and completed during the year were dry. One exploratory well started in December 1961 was down 4,492 feet and was still not drilled out at yearend. One old well was deepened 30 feet for development.

REVIEW BY COUNTIES

Table 7 shows the value of mineral production by counties. Only those counties with significant production are discussed in this review.

Butte.—Value of mineral production was one-half that of 1960. This decline of over $500,000 dropped the county from fifth to sixth place. Fire clay, mined in the county and processed by Black Hills Clay Products Co. at its Belle Fourche plant, was used for brick and tile. A small quantity of bentonite was mined by American Colloid Co. from a State lease within the county, but the bulk of bentonite processed at the company Belle Fourche plant came from Crook County, Wyo. IMC processed only bentonite from its operations in Crook County, Wyo., at its Belle Fourche plant. Processed bentonite from the two plants was mainly used in refractories, rotary drilling mud, and in pelletizing other materials. Utah-Idaho Sugar Co. made quicklime from purchased limestone at its Belle Fourche sugar plant. Stone and sand and gravel was produced for the State and county highway departments for road construction and maintenance.

Custer.—Value of mineral production was 1 percent less than in 1960. The county ranked fifth in value of mineral production.

TABLE 7.—Value of mineral production in South Dakota, by counties [1]

County	1960	1961 [2]	Minerals produced in 1961 in order of value
Aurora	$208,190	$32,345	Sand and gravel, stone.
Beadle	146,552	76,380	Do.
Bennett	(3)	----------	
Bon Homme	217,400	110,200	Sand and gravel.
Brookings	391,483	377,463	Sand and gravel, stone.
Brown	658,902	207,300	Sand and gravel.
Brule	99,196	62,709	Sand and gravel, stone.
Buffalo	73,210	28,700	Sand and gravel.
Butte	1,297,862	648,557	Clays, sand and gravel, lime, stone.
Campbell	(3)	31,700	Sand and gravel.
Charles Mix	348,800	139,038	Sand and gravel, stone.
Clark	454,200	77,877	Do.
Clay	34,900	38,800	Sand and gravel.
Codington	471,061	276,402	Sand and gravel, stone.
Corson	39,534	(3)	Sand and gravel.
Custer [4]	685,214	677,232	Uranium ore, feldspar, sand and gravel, beryllium concentrate, lime, mica (sheet), stone, gem stones, petroleum.
Davison	127,942	176,298	Sand and gravel, stone.
Day	378,900	71,861	Do.
Deuel	91,100	11,066	Do.
Dewey	167,584	95,047	Coal, sand and gravel, stone.
Douglas	289,000	141,683	Sand and gravel, stone.
Edmunds	42,000	76,776	Do.
Fall River [4]	642,825	317,340	Uranium ore, sand and gravel, stone, gem stones.
Faulk	121,100	103,000	Sand and gravel.
Grant	3,004,488	2,865,574	Stone, sand and gravel.
Gregory	242,322	100,853	Sand and gravel, stone.
Haakon	169,777	71,100	Sand and gravel.
Hamlin	7,959	14,028	Sand and gravel, stone.
Hand	22,277	56,900	Sand and gravel.
Hanson	500,152	(3)	Stone.
Harding	[4] 800,346	577,884	Petroleum, sand and gravel.
Hughes	420,990	256,793	Stone, sand and gravel.
Hutchinson	148,800	73,291	Sand and gravel, stone.
Hyde	2,549	25,200	Sand and gravel.
Jackson	46,625	----------	
Jerauld	51,900	65,580	Sand and gravel, stone.
Jones	5,390	14,500	Sand and gravel.
Kingsbury	110,202	74,876	Sand and gravel, stone.
Lake	285,120	117,800	Sand and gravel.
Lawrence	19,609,878	19,747,169	Gold, silver, stone, sand and gravel, gem stones, lead.
Lincoln	355,940	634,190	Sand and gravel, stone.
Lyman	66,573	22,709	Do.
Marshall	258,115	39,562	Do.
McCook	39,285	84,715	Do.
McPherson	163,000	32,400	Sand and gravel.
Meade	156,151	165,665	Stone, sand and gravel.
Mellette	78,343	4,500	Sand and gravel.
Miner	54,181	41,100	Do.
Minnehaha	1,842,250	1,922,908	Stone, sand and gravel.
Moody	180,064	158,732	Sand and gravel, stone.
Pennington	10,555,075	11,014,262	Cement, stone, sand and gravel, clays, iron ore, gypsum, beryllium concentrate, mica (scrap), feldspar, mica (sheet), gem stones.
Perkins	21,818	35,964	Sand and gravel, stone.
Potter	7,939	----------	
Roberts	242,063	80,200	Sand and gravel.
Sanborn	----------	1,900	Do.
Shannon	10,144	14,850	Sand and gravel, gem stones.
Spink	144,370	79,015	Sand and gravel, stone.
Stanley	131,345	34,900	Sand and gravel.
Sully	22,400	47,600	Do.
Todd	4,544	----------	
Tripp	31,118	86,509	Sand and gravel, stone.
Turner	228,115	188,400	Sand and gravel.
Union	236,653	418,200	Do.
Walworth	134,424	69,300	Do.
Yankton	164,800	56,800	Do.
Ziebach	12,375	30,401	Sand and gravel, stone.
Undistributed [5]	118,454	905,352	
Total [6]	46,780,000	42,980,000	

[1] Washabaugh is not listed because no production was reported.
[2] Value of petroleum is preliminary.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[4] Excludes vanadium.
[5] Includes production of lithium minerals (1960), vanadium, some sand and gravel and gem stones that cannot be assigned to specific counties, and values indicated by footnote 3.
[6] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

Of the 56 active feldspar mines in the State, 50 were in Custer County, and these accounted for 95 percent of the State feldspar production and value. Except for production from one operator, the feldspar went to the IMC grinding plant at Custer. Of the 20 operating mica mines in the State, 16 were in Custer County and accounted for 88 percent of the total value of sheet mica. All the hand-cobbed mica was purchased by GSA at the Custer purchasing depot, where the mica was processed by a private contractor. The resultant sheet mica was placed in the national stockpile. An eastern fabricator of block mica purchased some punch and washer grade mica from one producer. Limestone mined by Black Hills Lime Co. near Pringle was made into quicklime in two shaft kilns located at the mine site. The quicklime was sold for metallurgical use. Gem material, acquired by Allen's Minerals and Mining, W. L. Roberts, Scott Rose Quartz Co., and various individuals, accounted for 33 percent of the State's gem value. Production of sand and gravel increased 89 percent over that of 1960 because sand and gravel was used in building construction in addition to road construction.

Beryl output increased about 55 percent in both quantity and value over that of 1960. Although 44 of the 65 active mines in South Dakota were in Custer County, production from these mines accounted for only about one-third of the State's quantity and value of beryl. Uranium ore production was nearly triple that of 1960. Output from the county's four operations accounted for two-thirds of the State uranium ore production. Some vanadium contained in the uranium ore was recovered at the uranium mill at Edgemont.

For 6 months during 1961, oil was pumped from the county's only active oil well, in the Barker Dome field.

Fall River.—A sharp reduction in uranium ore production caused the county to drop out of the top ten producing counties; in 1960 it was rated ninth. Uranium ore production and the number of producing mines were both only about one-half those of 1960. Sand and gravel and stone production also were below the 1960 levels. About two-thirds of the sand and gravel output went into building; the remainder of the sand and gravel and all of the stone was used for road paving. Agate and uranium specimens were gathered by rock dealers and collectors.

Grant.—Grant County maintained its third position even though the value of mineral production was about $140,000 below that of 1960. Virtually all the county mineral value came from the sale of dimension granite blocks which were used as building and monumental stone. Granite was quarried for rough and dressed blocks at eight operations, compared with nine operations in 1960.

Harding.—Harding County dropped from fifth to eighth in mineral production value. A large part of the county value was due to oil production, which decreased 18 percent in value below that of 1960. The 19 wells which were producing in the Buffalo field at the end of 1960 pumped oil throughout 1961. There were no new producing wells. Four of the five exploratory wells started in 1961 were dry; the fifth was still not completed at yearend. The value of sand and gravel was only 12 percent of the 1960 value because of the small amount of road construction done during the year.

Lawrence.—The value of recovered gold, which accounted for 99 percent of the county's mineral production value, was more than enough to make the county number one in the State. All commodities produced in 1961 increased in both quantity and value, except gem stones, which decreased about 50 percent in value. Lead was a newcomer to the list of commodities produced in the county. The lead came from the Silver Queen mine near Deadwood, operated by Hage Bros., Inc.

TABLE 8.—Homestake mine ore milled, receipts, and dividends[1]

Year	Ore milled (thousand short tons)	Receipts for bullion product		Dividends (thousands)
		Total (thousands)	Per ton	
1957	1,660	$19,479	$11.74	$4,019
1958	1,725	19,611	11.37	4,019
1959	1,746	20,120	11.52	4,019
1960	1,767	19,465	11.02	4,021
1961	1,781	19,590	11.00	4,030

[1] From 1876 to 1961, inclusive, this mine yielded bullion and concentrates that brought a net return of $717.6 million and paid $214.9 million in dividends.

Homestake Mining Co. completed its 84th year of operating the Homestake mine at Lead. The Yates shaft marked its 20th year of hoisting gold ore in October 1961. Mill recovery of the gold contained in the ore was 97.28 percent, compared with 97.21 percent in 1960. The long-range ventilation program to provide cool air to all working levels was completed in 1961. Work was done throughout the year on the $1.5 million expansion program that was started in the late summer of 1960. This program consisted of developing the deeper levels for mining at 800 tons per day and enlarging the mill to handle the additional tonnage.

Lincoln.—Just over 1 million tons of sand and gravel and a few thousand tons of crushed stone were used for road construction. The sand and gravel production was about twice the 1960 quantity. The increase in sand and gravel production was due mainly to construction of a section of Interstate Highway 29 within the county. The value of the stone and sand and gravel output was enough to rank Lincoln County seventh in value of mineral production.

Minnehaha.—Minnehaha County ranked fourth in value of mineral production, the same position as in 1960. Sand and gravel production increased about one-third over 1960 whereas stone production decreased 4 percent. However, the changes in value almost offset each other. Most of the stone and sand and gravel went into road construction, which included parts of Interstate Highways 90 and 29 near Sioux Falls. Some stone was shipped by rail to the Oahe dam for use as riprap, filter blanket, and spalls.

Pennington.—The value of mineral production was one-quarter of the State total, and Pennington County was again second. The leading mineral product was cement. Stone production was 1.3 million tons, and sand and gravel production was 1.2 million tons. The county was the leading producer of these two commodities. Road construction, especially for Interstate Highway 90, consumed the larger part of these two commodities. However, slightly more than 500,000 tons of limestone was used for manufacturing cement at the South Dakota cement plant at Rapid City. The South Dakota Cement Commission purchased 195 acres of limestone-bearing property adjacent to the cement plant for $600,000.

One-third of the 65 active beryl mines were in Pennington County and accounted for 67 percent of the State beryl production. Iron ore was mined by Pete Lien & Sons near Rochford. The South Dakota Cement Commission purchased the iron ore and stockpiled it at the cement plant for use as a raw material in cement manufacturing.

Williams Bros., a Tulsa, Okla., engineering firm, began a survey to determine the feasibility of an oil refinery in the Black Hawk area.

Union.—Because sand and gravel production was twice the 1960 quantity, the county ranked ninth. The increase in sand and gravel was due to paving a section of Interstate Highway 29 in the western end of the county.

The Mineral Industry of Tennessee

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Tennessee Division of Geology.

By Lloyd Williams,[1] William D. Hardeman,[2] and Mildred E. Rivers[3]

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RECORD production of crushed limestone, phosphate rock, and crushed sandstone highlighted the mineral industry of Tennessee in 1961. Tennessee led the Nation in production of ball clay, pyrite, and zinc, ranked second in output of phosphate rock and dimension marble, and fourth in production of fuller's earth and dimension sandstone. The total value of mineral production was 3 percent more than in 1960, the previous record year.

TABLE 1.—Mineral production in Tennessee [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry .... thousand 280-pound barrels..	979	$2,696	1,018	$2,753
Portland .... thousand 376-pound barrels..	7,517	24,688	8,357	26,964
Clays .... thousand short tons..	1,270	4,537	[2] 1,040	[2] 4,190
Coal (bituminous) .... do....	5,930	21,154	5,860	20,681
Copper (recoverable content of ores, etc.) ... short tons..	12,723	8,168	12,272	7,363
Gem stones	(3)	1	(3)	1
Gold (recoverable content of ores, etc.) .... troy ounces..	123	4	152	5
Manganese ore (35 percent or more Mn) short tons, gross weight..	283	15	....	....
Natural gas .... million cubic feet..	63	11	71	13
Petroleum (crude) .... thousand 42-gallon barrels..	20	(4)	[5] 18	(4)
Phosphate rock .... thousand long tons..	1,939	15,424	2,235	18,675
Sand and gravel .... thousand short tons..	6,293	7,655	6,232	8,046
Silver (recoverable content of ores, etc.) .. troy ounces..	64,560	58	83,417	77
Stone .... thousand short tons..	20,074	29,942	23,940	35,906
Zinc (recoverable content of ores, etc.) ...... short tons..	91,394	23,580	81,734	18,799
Value of items that cannot be disclosed: Barite, fuller's earth (1961), iron ore, lime, manganiferous ore (1960), mica (1960), pyrite, and values indicated by footnote 4.	....	[6] 7,606	....	7,241
Total Tennessee [7]	....	[6] 143,476	....	147,262

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fuller's earth, included with "Value of items that cannot be disclosed."
[3] Weight not recorded.
[4] Figure withheld to avoid disclosing individual company confidential data.
[5] Preliminary figure.
[6] Revised figure.
[7] Total adjusted to eliminate duplicating the value of clays and stone.

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Leading industries were copper and zinc mining, stone quarrying, cement manufacturing, coal mining, phosphate rock mining and processing, and sand and gravel mining, which together furnished 95 percent of the total value of production. Leading companies were Tennessee Copper Co. (gold, silver, copper, pyrite, and zinc), American Zinc Co. of Tenn. (zinc and limestone), New Jersey Zinc Co. (zinc and limestone), Ideal Cement Co. (cement, limestone, and clay), and Penn-Dixie Cement Corp. (cement, limestone, and clay).

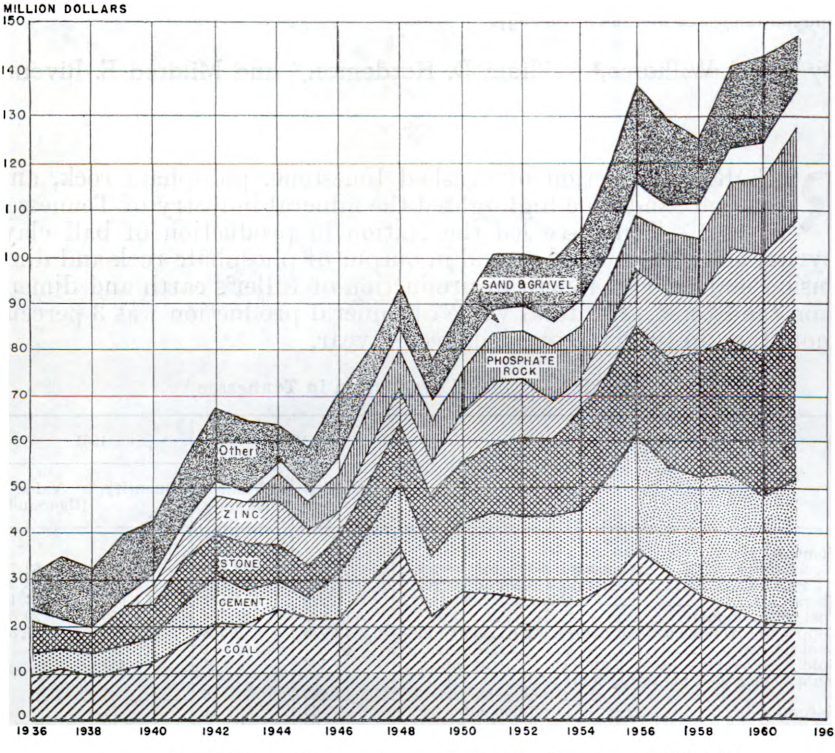

Figure 1.—Value of mineral production in Tennessee, 1936–61.

Employment and Injuries.—Total employment in the mineral industries decreased 8 percent below that in 1960. Employment decreased in all industries except quarries and mills, where it increased 2 percent.

Injury experience was about the same. Frequency rates were lower in all categories except coke ovens and smelters, and sand and gravel. There were 8 fatalities, compared with 14 in 1960 and 25 in 1959. There were no major disasters during the year.

Trends and Developments.—Although several zinc mines in East Tennessee were idle or working at reduced rates, new mine development and plant expansion continued. New Market Zinc Co., a joint venture of American Zinc Co. of Tennessee and Tri-State Zinc, Inc., began sinking a circular shaft to a planned depth of 2,100 feet and started constructing a flotation mill, which was to have a daily capacity of 2,800 to 3,500 tons. Cowin & Co., Inc., mining engineers and contractors, Birmingham, Ala., was awarded the contract for sinking the shaft, and Sanford-Day Iron Works of Knoxville was awarded the contract to fabricate the steel headframe. The site of the mill and shaft is 2 miles southwest of New Market, Tenn.

Tennessee Valley Authority (TVA) continued to construct the Melton Hill Dam in Loudon County in 1961. The dam will be 1,072 feet long and 80 feet high and will add 72,000 kilowatts to the TVA system. The TVA Bull Run steam electric plant was to be built on the shore of the Melton Hill reservoir in Anderson County. The first turbogenerator to be installed will have a capacity of 900,000 kilowatts, and plans provide for adding one to three more turbogenerators of the same capacity. TVA also was cooperating with the U.S. Atomic Energy Commission in erecting an experimental gas-cooled reactor with a capacity of 22,000 kilowatts, at the Oak Ridge Laboratories in Anderson County.

TABLE 2.—Employment and injuries in the mineral industries

Year and industry	Active operation	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960: [1]							
Quarries and mills	128	3,249	258	6,700,597	1	242	36
Coal mines	503	4,273	152	5,192,307	10	193	39
Coke ovens and smelters	3	1,173	365	3,425,358	----------	8	2
Metal mines and mills	21	1,525	248	3,030,585	2	80	27
Nonmetal mines and mills	37	1,345	221	2,397,627	----------	50	21
Sand and gravel mines	45	606	269	1,305,131	1	31	25
Total	737	12,171	226	22,051,605	14	604	28
1961: [2]							
Quarries and mills	179	3,304	260	6,888,257	----------	193	28
Coal mines [1]	555	3,979	144	4,589,167	6	159	36
Coke ovens and smelters	4	1,098	341	2,995,303	----------	9	3
Metal mines and mills	16	1,345	248	2,667,269	----------	35	13
Nonmetal mines and mills	33	1,115	218	1,940,396	2	37	20
Sand and gravel mines	37	586	269	1,261,664	----------	33	26
Total	824	11,427	223	20,342,056	8	466	23

[1] Excludes officeworkers.
[2] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Three operators mined crude barite from five mines in three counties for oil-well-drilling muds, chemicals, and other uses. The leading producer was B. C. Wood (Cedar Fork mine). Production decreased 39 percent and was 91 percent below that in 1941, the record year.

Cement.—Four companies produced masonry cement at five plants in five counties; the leading producer was Marquette Cement Manufacturing Co. Shipments increased 4 percent but were 5 percent below those in 1955, the record year. Consumption in Tennessee was 57 percent, and shipments were made to North Carolina (20 percent), Georgia (7 percent), South Carolina (7 percent), Alabama (3 percent), Kentucky (3 percent), and other States (3 percent).

Four companies produced portland cement at six plants in six counties. The leading producer was Penn-Dixie Cement Corp. Shipments increased 11 percent and were about the same as in the record year of 1959. Raw materials used in cement included cement rock and limestone (86 percent), clay and shale (8 percent), gypsum (3 percent), and other (3 percent). Consumption in Tennessee was 45 percent, and shipments were made to North Carolina (27 percent), Georgia (14 percent), Alabama (4 percent), Kentucky (3 percent), South Carolina (3 percent), Virginia (3 percent), and other States (1 percent).

Portland cement was used as follows: In ready mixed concrete (51 percent), in concrete products (17 percent), by highway contractors (12 percent), by building-materials dealers (10 percent), and in other ways (10 percent).

Marquette Cement Manufacturing Co. completed modernization at the Nashville plant in September; with the new equipment, featuring electronic and nucleonic devices, cement was to be produced at the rate of 1,200,000 barrels annually.

Clays.—Tennessee led in producing ball clay, five companies operated six mines in Henry and Weakley Counties. Leading producers were H. C. Spinks Clay Co., Inc., and United Clay Mines Corp. Production increased 2 percent but was 4 percent below the record in 1959.

Southern Clay Co., Inc., and Tennessee Absorbent Clay Co. mined fuller's earth in Henry County for absorbent uses. Production declined considerably. Tennessee ranked third in producing fuller's earth.

Twelve companies mined 750,000 tons of miscellaneous clay at 12 mines in 9 counties for floor and wall tile, heavy clay products, lightweight aggregate, and cement. Leading counties were Knox, Davidson, and Sullivan; leading producers were General Shale Products Corp. and W. G. Bush & Co., Inc. Production decreased 22 percent and was 28 percent below the record in 1956.

TABLE 3.—Ball clay sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Whiteware, etc	186,795	$2,555,302	$13.68	181,803	$2,493,587	$13.72
Floor and wall tile	48,578	665,946	13.71	47,376	654,304	13.81
Other [1]	47,601	627,097	13.17	60,541.	761,878	12.58
Total	282,974	3,848,345	13.60	289,720	3,909,769	13.49

[1] Includes heavy clay products, foundries and steelworks, firebrick and block, saggers, pins, stilts, wads, enameling, exports, and other uses.

Feldspar.—The Feldspar Corp. Erwin plant ground crude feldspar from North Carolina.

Gem Stones.—Collection of gem stones was reported from five counties. Bedford was the leading county, and agate was the predominant gem stone.

Lime.—Standard Lime & Cement Co., Knoxville, Williams Lime Mfg. Co., Knoxville, and Victor Chemical Works, Nashville, produced quicklime and hydrated lime for building, chemical, and industrial uses. Production decreased 19 percent. Consumption in Tennessee was 39 percent, and shipments were made to North Carolina (37 percent), Kentucky (9 percent), Ohio (4 percent), New York (3 percent), South Carolina (3 percent) and other States (5 percent).

Mica.—International Minerals & Chemical Corp. ceased production of scrap mica from silt deposits in Davy Crockett Lake near Greeneville. Harris Clay Co. purchased the Erwin mica grinding plant of International Minerals & Chemical Corp. and produced ground mica for paint, rubber, and welding rods from scrap shipped from North Carolina.

Perlite.—Tennessee Products & Chemical Corp. expanded crude perlite from Western States at the Nashville plant.

Phosphate Rock.—Nine companies mined and processed phosphate rock in Maury, Williamson, Giles, Davidson, and Hickman Counties. Leading producers were Monsanto Chemical Co. and Victor Chemical Works. Marketable production increased 15 percent above that in 1960, the previous record year. Tennessee ranked second in production of phosphate rock.

TABLE 4.—Phosphate rock sold or used by producers, by uses

Use	1960			1961		
	Long tons	Value		Long tons	Value	
		Total	Average per ton		Total	Average per ton
Elemental phosphorus	1,733,200	$13,588,388	$7.84	2,134,830	$17,629,436	[1] $8.26
Direct application to the soil	64,157	599,736	9.35	74,571	699,601	9.38
Ordinary superphosphate [2]	113,650	993,739	8.74	72,563	692,283	9.54
Other	[3] 16,495	[3] 137,626	[3] 8.34	9,234	77,577	8.40
Total	1,927,502	15,319,489	7.95	2,291,198	19,098,897	8.34

[1] Includes fertilizer filler, pig-iron blast furnace, and other fertilizer.
[2] Includes rock for phosphoric acid (wet process).
[3] Includes fertilizer filler, pig-iron blast furnace, and other uses.

Hooker Chemical Corp. added a third phosphate furnace at the Columbia, Tenn. plant. The expansion raised phosphorus capacity to 68,500 tons per year, representing an acid potential of 204,000 tons per year. Victor Chemical Corp. planned to produce sodium aluminum phosphate, a leavening agent for the baking industry, at its new Nashville plant.

Pyrite.—Tennessee Copper Co. recovered pyrite concentrate from sulfide ore mined in Polk County. Production decreased 2 percent below that in 1960 and in the record year of 1957. Tennessee continued to lead in output of pyrite.

Sand and Gravel.—Thirty-two companies mined sand and gravel at 39 mines in 30 counties. Leading counties were Shelby, Benton, and Davidson. Leading producers were Sangravel, Inc., Cumberland River Sand & Gravel Co., and Memphis Stone & Gravel Co., Inc. Production decreased 1 percent below the record in 1960. Of the total output, 91 percent was washed; 73 percent was hauled by truck; 18 percent, by rail; and 9 percent, by water.

American-Saint Gobain Corp., ranking third as a plate-glass producer in the United States, opened a new office and headquarters building in Kingsport at the end of the year. It operated the Blue Ridge Glass plant at Kingsport and was constructing a $55 million plate-glass plant at Greenland. The Ford Motor Co. acquired 32 acres adjoining its Nashville glass plant to expand the dike facility to impound waste sand and rouge used in grinding and polishing.

TABLE 5.—Sand and gravel sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Benton	702,788	$1,132,952	657,161	$1,094,997
Carter	------	------	15,000	15,000
Cumberland	55,000	67,000	(1)	(1)
Fayette	76,171	68,600	144,669	125,340
Franklin	54,964	87,423	(1)	(1)
Giles	290,250	190,000	175,000	140,000
Greene	26,980	32,418	(1)	(1)
Hamilton	280,063	436,487	(1)	(1)
Hardeman	21,890	16,490	(1)	(1)
Haywood	89,047	80,142	31,767	25,414
Lauderdale	83,754	75,379	97,063	77,650
Loudon	5,649	7,061	25,676	33,722
Maury	------	------	40,000	80,000
Monroe	12,599	18,886	14,217	21,325
Obion	102,200	92,000	117,420	93,936
Sevier	------	------	48,600	57,952
Shelby	1,711,898	1,502,531	1,297,067	1,097,834
Sumner	65,000	32,500	------	------
Tipton	(1)	(1)	298,270	294,116
Unicoi	259,004	364,658	329,863	491,113
Warren	(1)	(1)	58,000	87,000
Undistributed [2]	2,455,610	3,450,873	2,882,541	4,310,799
Total	6,292,867	7,655,400	6,232,314	8,046,198

[1] Figure withheld to avoid disclosing individual company confidential data: included with "Undistributed."

[2] Includes Carroll, Davidson, Decatur, Henderson, Humphreys, Knox, McNairy, Putnam, Stewart, Wayne, and counties indicated by footnote 1.

Stone.—Blue Ridge Stone Co. crushed 35,000 tons of granite in Carter County for concrete and roads. Eighty-eight operators crushed limestone at 117 quarries in 59 counties. Leading producing counties were Knox, Davidson, and Hamilton. Leading producers were Lambert Bros. Division of Vulcan Materials Co. (Blount, Claiborne, Davidson, Hawkins, Humphreys, Knox, Roane, Sevier, Sullivan, and Williamson Counties), and Chattanooga Rock Products Division of Vulcan Materials Co. (Hamilton and Marion Counties). Production

TABLE 6.—Sand and gravel sold or used by producers, by uses

Use	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	1,877,627	$2,574,511	$1.37	1,748,123	$2,605,059	$1.49
Paving	385,940	435,982	1.13	562,279	664,480	1.18
Molding	215,836	636,314	2.95	208,727	608,823	2.92
Engine	864	1,080	1.25	1,037	1,555	1.50
Other sand	(1)	(1)	(1)	355,966	734,692	2.06
Total	(1)	(1)	(1)	2,876,132	4,614,609	1.60
Gravel:						
Paving	1,572,104	1,268,575	0.81	1,981,599	1,651,418	0.83
Structural	1,803,774	2,098,427	1.16	1,258,570	1,625,844	1.29
Fill	101,250	50,000	.49	(2)	(2)	(2)
Other gravel	(1)	(1)	(1)	116,013	154,327	1.33
Total	(1)	(1)	(1)	3,356,182	3,431,589	1.02
Total sand and gravel	6,292,867	7,655,400	1.22	6,232,314	8,046,198	1.29

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Other gravel."

was 19 percent above the record in 1960. Of the total production, 85 percent was hauled by truck; 8 percent by waterway; and 7 percent, by rail. Tortina & Brown produced 108 tons of dimension limestone.

John J. Craig Co., Appalachian Marble Co., and Knoxville Crushed Stone Co. crushed marble for terrazzo and other uses. Production increased 11 percent, but was 50 percent below the record in 1948. John J. Craig Co. (Hamil, Marmor, Crisp, and Lee quarries), Tennessee Marble Co. Division of Georgia Marble Co. (Endsley, Eagle, and Luttrell No. 3 quarries), Gray Knox Marble Co. (French Pink, Brown, and Gray Knox quarries), and Appalachian Marble Co. (Bond and Appalachian quarries) quarried dimension marble in Blount, Knox, and Union Counties. Production increased 22 percent but was 19 percent below the record in 1957. Tennessee ranked second in production of dimension marble.

White Silica Sand Co., Sewanee Silica Co., and Major Sand Co., Inc., crushed 220,000 tons of sandstone. Eleven companies quarried dimension sandstone at 11 quarries in Cumberland and Fentress Counties for rough architectural, sawed, and dressed building stone and for flagging. Leading producers were Tennessee Stone Co., Inc., and Crab Orchard Stone Co., Inc. Production decreased 23 percent and was 47 percent below the record in 1955. Tennessee ranked fourth in production of dimension sandstone.

Vermiculite.—Zonolite Co. exfoliated vermiculite shipped from other States at its Nashville plant.

TABLE 7.—Crushed limestone sold or used by producers, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Blount	315,887	$455,133	343,752	$509,019
Claiborne	67,693	90,938	77,979	103,654
Clay	-----	-----	40,000	60,000
Cocke	42,318	48,828	37,500	45,000
Davidson	2,363,647	2,664,980	2,159,014	2,368,629
Decatur	284,631	355,789	494,870	611,210
De Kalb	57,123	57,123	60,500	60,500
Fayette	-----	-----	68,186	85,914
Fentress	123,820	152,560	151,900	204,600
Franklin	711,572	815,680	717,071	879,411
Giles	240,000	336,000	240,000	336,000
Grainger	-----	-----	41,847	52,450
Grundy	26,602	30,905	45,777	50,772
Hamblen	375,780	498,127	402,000	491,182
Hancock	-----	-----	60,000	75,600
Hawkins	14,611	18,522	100,683	133,282
Humphreys	537,109	713,941	577,210	792,719
Knox	1,780,342	1,981,132	3,321,704	4,922,474
Lawrence	-----	-----	20,793	29,059
Lincoln	71,933	92,074	96,270	120,338
Macon	123,328	166,492	142,309	192,116
Marion	766,748	988,637	865,335	1,116,402
Sevier	299,007	439,594	131,844	185,373
Sullivan	425,390	553,413	(1)	(1)
Sumner	(1)	(1)	368,969	419,002
Unicoi	36,615	46,867	5,760	7,258
Union	18,000	23,040	30,000	37,500
Washington	182,435	209,800	378,000	440,730
Wayne	(1)	(1)	(1)	(1)
White	(1)	(1)	269,005	321,020
Williamson	350,741	446,751	457,498	604,361
Wilson	649,061	547,497	780,890	735,208
Undistributed [2]	10,008,619	13,002,812	11,095,563	14,513,952
Total	19,873,012	24,736,635	23,582,229	30,504,735

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[2] Includes Anderson, Bedford, Bradley, Campbell, Cannon, Carter, Coffee, Cumberland, Dickson (1960), Greene, Hamilton, Jefferson, Johnson, Loudon, Marshall, Maury, McMinn, Meigs, Monroe, Montgomery, Overton (1961), Putnam, Rhea, Roane, Robertson, Rutherford, Sequatchie, Smith, Warren and counties indicated by footnote 1.

TABLE 8.—Crushed limestone sold or used by producers, by uses

Uses	1960			1961		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	15,329,811	$19,101,191	$1.25	19,032,061	$23,687,729	$1.24
Cement and lime	2,123,524	1,994,259	.94	2,219,231	3,382,470	1.52
Agstone	1,304,610	1,984,169	1.52	1,390,923	1,949,195	1.40
Railroad ballast	587,318	759,831	1.29	345,778	409,972	1.19
Stone sand	208,767	306,516	1.47	224,753	326,471	1.45
Riprap	18,492	18,398	.99	(1)	(1)	(1)
Other [2]	300,490	572,271	1.90	369,483	748,898	2.03
Total	19,873,012	24,736,635	1.24	23,582,229	30,504,735	1.29

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes glass, mineral food, asphalt filler, fluxing stone, rock dust for coal mines, paper, fertilizer filler, filter beds, other uses, and uses indicated by footnote 1.

TABLE 9.—Dimension marble sold or used by producers, by uses

Use	1960			1961		
	Quantity, cubic feet	Value		Quantity, cubic feet	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
Building stone:						
Interior, cut, dressed	112,200	$2,229,058	$19.87	94,270	$1,845,000	$19.57
Interior, sawed, dressed	70,326	705,249	10.03	(1)	(1)	(1)
Other uses [2]	231,449	462,893	2.00	418,326	1,458,948	3.49
Total	413,975	3,397,200	8.21	512,596	3,303,948	6.45

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other uses."
[2] Includes exterior and interior building stone, monumental stone, and uses indicated by footnote 1.

MINERAL FUELS

Coal (Bituminous).—Bituminous coal was mined at 391 mines in 16 counties, compared with 415 mines in 17 counties in 1960. Leading producing counties were Anderson, Marion, and Campbell. Leading producers were Clinchfield Coal Co. (Meadow Creek mine), Pocahontas Fuel Co. (Morco mine), and Tennessee Products & Chemical Corp. (Reels Cove mine). Production was 1 percent less than in 1960 and 34 percent below the record in 1956. Average production per mine increased from 14,300 to 15,000 tons.

The Tennessee Valley Authority (TVA) optioned the mining rights on 52,942 acres in Campbell and Scott Counties from Koppers Co., Inc., for $40,000. TVA planned to buy the property as a coal reserve for the Bull Run steam plant, which was to be under construction in 1962. Tennessee Products & Chemical Corp. was planning a new mine to replace the Reels Cove mine, which was to be virtually worked out in 1962.

In the northern part of the State (District 8), 246 mines in 9 counties produced 4,296,000 tons of coal, compared with 267 mines in 9 counties that produced 4,235,000 tons in 1960. Average production per mine increased from 15,900 to 17,500 tons. Underground mines produced 61 percent of the total; strip mines, 33 percent; and auger mines, 6 percent. Shipments were 70 percent by rail or water and 30 percent by truck. Captive tonnage was 2 percent of the total.

Equipment used at 184 underground mines included 130 cutting machines that cut 83 percent of the total tonnage, 157 power drills that drilled 85 percent, 66 locomotives, 34 shuttle cars, 6 mother conveyors, 22 mobile loading machines that loaded 53 percent, 2 continuous mining machines that loaded 5 percent, and 41 face conveyors that loaded 12 percent. Equipment used at 51 strip mines included 87 power shovels, 1 dragline, 33 bulldozers, 18 power drills, and 116 trucks. Equipment used at 11 auger mines included 12 coal-recovery augers, 10 bulldozers, 2 power drills, and 34 trucks. Twenty-two percent of the coal was crushed, and 2 percent was cleaned.

In the southern part of the State (District 13), 145 mines in 7 counties produced 1,564,000 tons, compared with 148 mines in 8 counties that produced 1,695,000 tons in 1960. Average production

TABLE 10.—Coal (bituminous) production, by counties

County	1960		1961	
	Short tons	Value	Short tons	Value
Anderson	1,613,244	$5,999,046	1,447,461	$5,724,433
Bledsoe	23,268	75,317	26,606	89,459
Campbell	643,181	2,190,859	1,086,875	3,619,701
Claiborne	246,083	887,181	319,629	1,020,150
Cumberland	84,400	326,430	27,548	83,530
Fentress	104,384	299,777	75,132	226,446
Grundy	167,859	723,948	184,998	775,592
Hamilton	37,062	116,745	27,180	92,254
Marion	816,768	2,640,668	680,422	2,206,066
Morgan	479,764	1,772,250	326,496	995,345
Overton	118,278	238,665	81,662	227,836
Putnam	391,986	1,723,342	463,520	1,866,454
Rhea	80,278	188,653	55,793	177,979
Scott	554,076	2,024,331	467,665	1,408,101
Sequatchie	505,528	1,750,286	438,515	1,638,747
Van Buren	62,491	192,470	150,186	528,868
White	1,800	4,050		
Total	5,930,450	21,154,018	5,859,688	20,680,961
Earliest record to date	394,428,000	(1)	400,288,000	(1)

[1] Data not available

per mine decreased from 11,500 to 10,800 tons. Underground mines produced 78 percent of the total, strip mines produced 21 percent, and auger mines produced 1 percent. Shipments were 76 percent by rail or water and 24 percent by truck. The coal was sold in the open market mainly to TVA.

Equipment used in 130 underground mines included 77 cutting machines that cut 74 percent of the total tonnage, 126 power drills that drilled 81 percent, 45 locomotives, 8 shuttle cars, 4 mother conveyors, 9 mobile loading machines that loaded 13 percent, and 12 face conveyors that loaded 16 percent. Equipment used at 14 strip mines included 22 power shovels, 3 draglines, 14 bulldozers, 9 power drills, and 24 trucks. Equipment used at 1 auger mine included 1 coal-recovery auger and 3 trucks. Of the total tonnage, 12 percent was crushed.

Coke.—Tennessee Products & Chemical Corp. produced metallurgical coke in byproduct coke ovens at Chattanooga. In June, Chemcoke, formerly Peabody-Wright Corp., built and began operating a small carbonization plant adjacent to a chemical plant near Columbia. The unit was designed to produce 40,000 tons of chemical coke per year for use in producing elemental phosphorus. The product was to be tested by several companies to determine its suitability to their operations. The company planned to sell the coal gas generated to a chemical plant as fuel.

Natural Gas.—Marketed production of natural gas increased 3 percent. At the end of the year, 23 gas wells were producing. Cumulative production of natural gas since 1916 was 3,354 million cubic feet.

Petroleum.—Production of crude petroleum was 10 percent less than in 1960. At yearend 30 oil wells were producing. Cumulative production since 1916 was 633,000 barrels valued at $1,066,000.

METALS

Copper.—Tennessee Copper Co. recovered copper concentrate from sulfide ore mined in Polk County. Production of recoverable copper decreased 4 percent below the record in 1960. The company completed sinking the Cherokee shaft to the 14th level and started driving drifts for access to the ore body. The old Westervelt shaft (240 feet deep) and drifts were reopened to provide an airway and additional access to the ore body. A new fluidized-bed roaster based on suspension of solids in a stream of gas was put into operation at Copperhill.

Ferroalloys.—Shipments of ferromanganese, silicomanganese, ferrosilicon, ferrochromium, ferrochromic silicon, and ferrophosphorus totaled 115,268 tons valued at $18,600,549, compared with 83,000 tons valued at $10,861,000 in 1960.

Gold.—Tennessee Copper Co. recovered gold as a byproduct from smelting copper and zinc concentrates. Production increased 24 percent but was 78 percent below the record in 1930.

Iron Ore.—Big Flag Springs Mining Co. mined brown iron ore in Blount County, and Rockwood Mining Corp. mined red iron ore in Roane County. Production of iron ore decreased 61 percent and was 98 percent below the record in 1902.

Pig Iron.—Tennessee Products & Chemical Corp. produced foundry, basic, low-phosphorus, malleable, and chrome-bearing pig iron at Rockwood and Wrigley. Shipments declined 4 percent. Iron ore imported from Chile comprised 2 percent of the iron ore consumed.

Silver.—Tennessee Copper Co. recovered silver as a byproduct from smelting copper and zinc concentrates. Production increased 29 percent but was 25 percent below the record in 1920.

Zinc.—Tennessee continued to lead in zinc production although output decreased 11 percent below the record in 1960.

American Zinc Co. of Tennessee operated the Young, Coy, and Grasselli mines in Jefferson County and the Mascot No. 2 mine in Knox County. New Jersey Zinc Co. operated the Jefferson City mine in Jefferson County and the Flat Gap mine in Hancock County. Tennessee Coal & Iron Division of United States Steel Corp. operated the Zinc Mine Works in Jefferson County. Tennessee Copper Co. recovered zinc concentrate from copper-zinc ores mined in Polk County. Total crude ore milled was 3,664,000 tons. An estimate, based on mineral rights acquired by zinc companies and average content of drilled properties, indicated an ore reserve of 10 million tons of zinc concentrates in East Tennessee. New Market Zinc Co., a joint venture of American Zinc Co. of Tennessee and Tri-State Zinc, Inc., completed engineering plans for a 2,100-foot-deep circular shaft to be sunk at New Market. The 2,800 to 3,500 tons per day concentrator was expected to be completed by September 1962 and was to treat ores from the Coy, Grasselli, and Young mines of American Zinc Co. of Tennessee until completion of the New Market shaft and underground development. American Zinc Co. closed all mines except the Young and the Mascot No. 2 mines during the year.

In November, New Jersey Zinc Co. was forced to stop production at its Jefferson City zinc mine when a drift on the sixth level cut a water-bearing fault and quickly flooded the mine to the third level; dewatering of the mine was progressing at yearend. Because of market conditions, the company's Flat Gap mine was shut down during April.

Tennessee Coal & Iron planned to install a new automatic hoisting system at its Jefferson City Zinc mine.

Exploration and development at zinc and copper-zinc mines included: Diamond drilling, 65,395 feet; percussion drilling, 70,243 feet; drifting, 33,252 feet; raising, 5,152 feet; churn drilling, 4,416 feet; winzing, 27 feet; shaft sinking, 43 feet; and inclining, 2,110 feet.

TABLE 11.—Mine production of recoverable gold, silver, copper, lead, and zinc

Year	Gold		Silver		Copper		Lead		Zinc		Total
	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)	Short tons tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Value (thousands)
1952-56 (average)	232	$8	63,752	$58	8,979	$5,963	6	$2	38,610	$10,105	$16,136
1957	172	6	54,407	49	9,790	5,893	----------	----------	58,063	13,471	19,419
1958	124	4	44,592	41	9,109	4,791	----------	----------	59,130	12,063	16,899
1959	99	3	59,739	54	11,490	7,055	----------	----------	89,932	20,684	27,796
1960	123	4	64,560	58	12,723	8,168	----------	----------	91,394	23,580	31,810
1961	152	5	83,417	77	12,272	7,363	----------	----------	81,734	18,799	26,244
1831-1961	24,024	583	3,858,432	2,855	519,080	185,667	27,092	3,176	1,525,466	305,925	498,206

REVIEW BY COUNTIES

Mineral production was reported from 79 counties; the leading counties were Knox, Polk, Jefferson, Maury, and Davidson. In addition to the commodities listed in table 12, small quantities of oil and gas, the county origin of which was undetermined, were produced.

Anderson..—Pocahontas Fuel Co. (Morco colliery), Windrock Coal & Coke Co. (Windrock No. 2 mine), and Tennessee Auger Co. (No. 1 Strip mine) were the leading producers of the 50 active coal mines. Ralph Rogers & Co., Inc. (Oak Ridge quarry), and Anderson County Highway Department (Taylor's quarry No. 1) crushed limestone for concrete, roads, and stone sand. Lalite Corp. (Briceville mine) mined miscellaneous clay for lightweight aggregate.

Bedford.—A & R Stone Co., Inc. (Shelbyville quarry), and Bedford County Highway Department (Delton Baker quarry) crushed limestone for concrete, roads, and agstone. E. B. Hammons and Virgil Owens collected small quantities of gem stones (agate and chalcedony).

Benton.—Four mines produced sand for glass, molding, and grinding and polishing; the leading producer was Hardy Sand Co. (Silica and Camden mines). Camden Gravel Co. and Memphis Stone & Gravel Co. mined paving gravel.

TABLE 12.—Value of mineral production in Tennessee, by counties [1]

County	1960	1961	Minerals produced in 1961 in order of value [2]
Anderson	(3)	(3)	Coal, limestone, miscellaneous clay.
Bedford	(3)	(3)	Limestone, gem stones.
Benton	$1,132,952	$1,094,997	Sand and gravel.
Bledsoe	75,317	89,459	Coal.
Blount	(3)	(3)	Marble, limestone, iron ore.
Bradley	(3)	(3)	Limestone.
Campbell	2,624,577	4,312,417	Coal, limestone, sandstone.
Cannon	(3)	(3)	Limestone.
Carroll	(3)	(3)	Sand and gravel.
Carter	(3)	(3)	Limestone, granite, sandstone, sand and gravel.
Claiborne	978,119	1,123,804	Coal, limestone.
Clay	----------	60,000	Limestone.
Cocke	82,128	45,000	Do.
Coffee	(3)	(3)	Limestone, gem stones.
Cumberland	(3)	(3)	Sandstone, limestone, sand and gravel, coal.
Davidson	10,249,335	9,735,992	Cement, limestone, phosphate rock, sand and gravel, lime, miscellaneous clay.
Decatur	(3)	(3)	Limestone, sand and gravel.
De Kalb	57,123	60,500	Limestone.
Dickson	(3)	----------	
Fayette	68,600	211,254	Sand and gravel, limestone.
Fentress	456,937	431,406	Coal, limestone, sandstone.
Franklin	4,368,947	4,447,697	Cement, limestone, sand and gravel, miscellaneous clay, gem stones.
Giles	(3)	2,347,131	Phosphate rock, limestone, sand and gravel.
Grainger	----------	52,450	Limestone.
Greene	(3)	(3)	Limestone, sand and gravel.
Grundy	754,853	(3)	Coal, sandstone, limestone.
Hamblen	498,127	491,182	Limestone.
Hamilton	6,684,360	7,586,328	Cement, limestone, sand and gravel, coal.
Hancock	(3)	(3)	Zinc ore, limestone.
Hardeman	16,490	(3)	Sand and gravel.
Hawkins	19,022	133,282	Limestone.
Haywood	80,142	25,414	Sand and gravel.
Henderson	(3)	(3)	Do.
Henry	(3)	(3)	Ball clay, fuller's earth.
Hickman	(3)	(3)	Phosphate rock.
Humphreys	(3)	(3)	Limestone, sand and gravel.
Jefferson	(3)	(3)	Zinc ore, limestone.
Johnson	(3)	(3)	Limestone.
Knox	16,607,235	19,656,387	Cement, limestone, zinc ore, marble, lime, sand and gravel, miscellaneous clay.
Lauderdale	75,379	77,650	Sand and gravel.
Lawrence	----------	29,059	Limestone.
Lincoln	92,074	120,438	Limestone, gem stones.
Loudon	116,374	(3)	Limestone, barite, sand and gravel, miscellaneous clay.
Macon	166,492	192,116	Limestone.
Marion	(3)	(3)	Cement, coal, limestone.
Marshall	(3)	(3)	Limestone.
Maury	10,701,807	12,526,212	Phosphate rock, limestone, sand and gravel.
McMinn	(3)	(3)	Limestone, barite.
McNairy	(3)	(3)	Sand and gravel.
Meigs	(3)	(3)	Limestone.
Monroe	(3)	(3)	Limestone, sand and gravel, barite.
Montgomery	(3)	(3)	Limestone.
Morgan	1,772,250	995,345	Coal.
Obion	92,000	93,936	Sand and gravel.
Overton	238,665	(3)	Coal, limestone.
Polk	(3)	(3)	Copper, pyrite, zinc ore, silver, gold.
Putnam	(3)	(3)	Coal, limestone, sand and gravel.
Rhea	(3)	(3)	Coal, limestone, miscellaneous clay.
Roane	(3)	(3)	Limestone, iron ore.
Robertson	(3)	(3)	Limestone.
Rutherford	(3)	(3)	Do.
Scott	2,024,331	1,408,101	Coal.
Sequatchie	(3)	(3)	Coal, limestone.
Sevier	439,594	249,601	Limestone, sand and gravel.
Shelby	1,560,284	1,117,834	Sand and gravel, miscellaneous clay.
Smith	(3)	(3)	Limestone.

See footnotes at end of table.

TABLE 12.—Value of mineral production in Tennessee, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value[2]
Stewart	(3)	(3)	Sand and gravel.
Sullivan	(3)	(3)	Cement, limestone, miscellaneous clay.
Sumner	(3)	$419,002	Limestone.
Tipton	(3)	294,116	Sand and gravel.
Unicoi	$426,104	498,371	Sand and gravel, limestone.
Union	(3)	287,900	Marble, limestone.
Van Buren	192,470	528,868	Coal.
Warren	(3)	(3)	Limestone, sand and gravel.
Washington	(3)	459,730	Limestone, miscellaneous clay.
Wayne	(3)	(3)	Sand and gravel, limestone.
Weakley	1,910,144	(3)	Ball clay.
White	(3)	321,120	Limestone, gem stones.
Williamson	(3)	(3)	Phosphate rock, limestone.
Wilson	547,497	735,208	Limestone.
Undistributed[4]	[5] 78,366,271	75,002,693	
Total	[5] 143,476,000	147,262,000	

[1] The following counties are not listed because no production was reported: Cheatham, Chester, Crockett, Dyer, Gibson, Hardin, Houston, Jackson, Lake, Lewis, Madison, Moore, Perry, Pickett, Trousdale.

[2] Petroleum and natural gas not listed by counties as data are not available; value included with "Undistributed."

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[4] Includes value of petroleum and natural gas and values indicated by footnote 3.

[5] Revised figure.

Bledsoe.—Six coal mines were active; leading producers were BDSS Coal Co. (No. 1 mine) and Waters Coal & Construction Co. (No. 3 strip mine).

Blount.—Big Flag Springs Mining Co. mined brown-iron ore at the Wilson mine. John J. Craig Co. (Marmor, Crisp, Hamil, and Lee quarries), Tennessee Marble Co. (Endsley quarry), and Gray Knox Marble Co. (Brown and French Pink quarries) quarried dimension marble for rough and dressed building stone and dressed monumental stone. John J. Craig Co. crushed marble for terrazzo and other uses. Lambert Bros. Division of Vulcan Materials Co. (Maryville quarry) crushed limestone for concrete, roads, and agstone.

Bradley.—Bradley Limestone Co., Inc. (Welch quarry), and Bradley County Highway Department crushed limestone for concrete, roads, and agstone

Campbell.—Sixty-five coal mines were active; leading producers were Dixie Pine Coal Co, Inc. (No. 1 Strip mine), Rich Gap Coal Corp. (Rich Gap Strip mine), and Cox Coal Co. (No. 3 Strip mine). Key Limestone (LaFollette quarry) and Jellico Stone Co., Inc. (Jellico quarry), crushed limestone for concrete, roads, agstone, and stone sand. One producer crushed sandstone for concrete, roads, abrasives, and filler.

Cannon.—Woodbury Stone Co. (Norvell quarry) crushed limestone for concrete, roads, and agstone.

Carroll.—Hardy Sand Co. (Bruceton mine) mine structural, and grinding and polishing sand.

Carter.—Watauga Stone Co. crushed limestone for concrete, roads, railroad ballast, and stone sand. Blue Ridge Stone Co. (Greer quarry) and Carter County Highway Department crushed granite for concrete and roads. Major Sand Co., Inc. (Elizabethton quarry), crushed sandstone for concrete and roads. The County Highway department mined paving gravel.

Claiborne.—Twenty-five coal mines were active; Acorn Coal Co. (No. 1 Strip and No. 1 Auger mines) and Harris Branch Coal Co. (No. 1 mine) were the leading producers. Lambert Bros. (Tazewell quarry) crushed limestone for concrete and roads.

Clay.—Dixie Limestone Co. crushed limestone for concrete, roads, and agstone.

Cocke.—Cocke County Highway Department (Smith quarry) crushed limestone for concrete and roads.

Coffee.—Ralph Rogers & Co., Inc. (Coffee quarry), and Coffee County Highway Department (Winton quarry) crushed limestone for concrete, roads, agstone, and stone sand. Virgil Owens and Richard Matych collected small quantities of gem stones (agate, jasper, and geodes).

Cumberland.—Seven coal mines were active; leading producers were Ben Donelson Coal Co. (Bryant Mill Hollow Strip mine) and Smith & Welch Coal Co. (No. 1 mine). Ten companies quarried dimension sandstone for rough architectural, sawed and dressed building stone, and flagging. The leading producers were Tennessee Stone Co., Inc. (McGuire quarry), and Crab Orchard Stone Co., Inc. (Peck quarry). Southern States Lime Corp. (Crab Orchard mine) and Cumberland County Highway Department (county quarry) produced limestone for fluxing stone, concrete, roads, railroad ballast, agstone, glass, paper, rock dust for coal mines, filter beds, mineral food, and other uses. Potter Sand & Gravel Co. (Crossville mine) mined structural and paving sand and gravel.

Davidson.—Davidson County ranked fifth in total value of mineral production. Marquette Cement Mfg. Co. produced masonry and portland cements at the Nashville mill. Seven quarries produced limestone for riprap, concrete, roads, railroad ballast, agstone, asphalt filler, and fertilizer filler; the leading producers were Lambert Bros. (Danley and Hermitage quarries) and Menifee Crushed Stone Co. (Nashville quarry).

Monsanto Chemical Co. mined phosphate rock. Cumberland River Sand & Gravel Co. and Tennessee State Highway Department mined structural and paving sand and gravel. Victor Chemical Works produced lime for industrial uses. W. G. Bush & Co., Inc. (Nashville mine), mined miscellaneous clay for cement and heavy clay products. Tennessee Products & Chemical Corp. expanded crude perlite from Western States at the Nashville plant. Zonolite Co. exfoliated crude vermiculite from South Carolina and Montana at the Nashville mill.

Decatur.—Western Materials, Inc. (Parsons quarry), crushed limestone for concrete, roads, and agstone. Teague Bros. Sand & Gravel Co. and Tinker Sand & Gravel Co. mined structural sand and gravel.

De Kalb.—De Kalb County Highway Department crushed limestone for concrete and roads at the Chapman Hollow quarry.

Fayette.—Fayette County Highway Commission mined paving gravel and crushed limestone for concrete and roads.

Fentress.—Fourteen coal mines were active; leading producers were Hollis Miller Coal Co. (New No. 3 mine), Long Branch Coal Co. (Long Branch mine), and Wilder Mountain Coal Co. (Wilder Mountain mine). Frogge & Williams, Inc. (Wright quarry), crushed limestone for concrete, roads, and agstone. Kentucky-Tennessee Stone Co. (Jamestown quarry) quarried dimension standstone for rough architectural stone and flagging.

Franklin.—Marquette Cement Mfg. Co. produced masonry and portland cements at the Cowan mill throughout the year. Cowan Stone Co. (Cowan quarry and Anderson mine), Marquette Cement Mfg. Co., and Franklin County Highway Department (Bostick quarry) crushed limestone for cement, fluxing stone, concrete, roads, railroad ballast, agstone, and other uses. Estill Springs Sand-Gravel Co. mined structural sand and gravel. Marquette Cement Mfg. Co. mined miscellaneous clay for use in cement manufacture. Virgil Owens collected a small quantity of gem stones (jasper).

Giles.—Monsanto Chemical Co., International Minerals & Chemical Corp. and M. C. West mined phosphate rock. Cedar Grove Lime Co. crushed limestone for concrete, roads, and agstone. Giles County Highway Department mined paving and fill gravel.

Grainger.—Grainger County Highway Department (Mitchell's and Capp's quarries) crushed limestone for concrete and roads.

Greene.—Malone Bros. Quarry, Inc., Agricultural Lime Co., Inc. (Greenville quarry), and Greene County Highway Department (Midway quarry) crushed limestone for concrete, roads, and agstone. Nolichuckey Sand Co. (Bewley mine) and Buster Sand Co. mined structural sand and gravel.

Grundy.—Seven coal mines were active; leading producers were Ramsey Coal Co. (No. 1 Strip mine), Phipps & Sons Coal Co. (Commando Strip mine), and Cumberland Coal Co. (No. 1 Strip mine). Sewanee Silica Co. (Monteagle quarry) crushed sandstone for concrete, roads, abrasives, glass, pottery, and other uses. Viola White Lime Co. (Old State quarry) crushed limestone for concrete, roads, and agstone.

Hamblen.—White Pine Stone Co. (Hamblen quarry) and Hamblen County Highway Department crushed limestone for concrete and roads.

Hamilton.—Eleven coal mines were active; leading producers were Russell Mining Co. (No. 7 Strip mine), Dave Frizzell Coal Co. (No. 1 mine), and Savage Coal Co. (Millsap mine). Signal Mountain Portland Cement Division of General Portland Cement Co. produced masonry and portland cements at the Signal Mountain mill throughout the year. Chattanooga Rock Products, Division of Vulcan Materials Co. crushed limestone for concrete, roads, railroad ballast, and agstone. Dixie Sand & Gravel Corp. mined structural sand and gravel.

Hancock.—New Jersey Zinc Co. recovered zinc from zinc ore mined at the Flat Gap mine; the mine was idle most of the year. Hancock County Highway Department crushed limestone for concrete and roads.

Hardeman.—Tri-State Sand Co. (Saulsbury mine) mined structural sand.

Hawkins.—Lambert Bros. crushed limestone for concrete and roads at the McCloud quarry.

Haywood.—Haywood County Highway Department (county mine) mined paving gravel.

Henderson.—Ayers Mineral Co. mined molding sand at the Zane mine.

Henry.—Kentucky-Tennessee Clay Co. (Tennessee mine), H. C. Spinks Clay Co., Inc., and Laird Brick Co. (Puryear mine) mined ball clay for whiteware, floor and wall tile, refractories, heavy clay products, and exports. Southern Clay Co., Inc., and Tennessee Absorbent Clay Co. mined fuller's earth for absorbent uses.

Hickman.—M. C. West and M. C. Boyle Phosphate Co. (Bratton mine) mined phosphate rock for agricultural uses.

Humphreys.—Lambert Bros. (Rock Hill quarry) crushed limestone for concrete, roads, railroad ballast, and agstone. Sangravel Co., Inc. (Jacksonville mine), and the State highway department mined sand and gravel for structural and paving uses.

Jefferson.—Jefferson County ranked third in total value of mineral production. New Jersey Zinc Co. (Jefferson City mine), American Zinc Co. of Tennessee (Young and Coy mines), and Tennessee Coal & Iron Division of United States Steel Corp. (Zinc Mine Works) recovered zinc from zinc ores. Limestone was produced by the Jefferson County Highway Department and also recovered as a byproduct from zinc mines; this material was used for concrete, roads, railroad ballast, agstone, and stone sand.

Johnson.—Maymead Lime Co., Inc. (Maymead quarry), crushed limestone for concrete, roads, and agstone.

Knox.—Knox County led in total value of mineral production. American Zinc Co. of Tennessee (Mascot No. 2 mine) mined zinc ore and recovered limestone as a byproduct. Ideal Cement Co. produced masonry and portland cements at the Knoxville mill throughout the year. Nine quarries and one mine crushed limestone for concrete, roads, cement, lime, railroad ballast, and other uses. Leading producers were Lambert Bros. (Dixie Lee, Lamon, City and Kennedy quarries) and Ideal Cement Co. (Knoxville quarry).

Gray Knox Marble Co. (Gray Knox quarry), Appalachian Marble Co. (Bond and Appalachian quarries), and Tennessee Marble Co. (Eagle quarry) quarried dimension marble for rough and dressed building stone and dressed sawed monumental stone. Stone Road Quarries and Appalachian Marble Co. crushed marble for terrazzo and other uses. Williams Lime Mfg. Co. and Standard Lime & Cement Division, Martin Marietta Corp., produced lime for building, chemical, and industrial uses. Oliver King Sand & Lime Co., Inc., (King mine), and Knoxville Sand & Gravel Co. mined structural, paving, grinding and polishing, and engine sands, and structural and paving gravel. Shalite Corp. (Shalite mine), General Shale Products Co. (Knoxville mine), and Ideal Cement Co. mined miscellaneous clay for lightweight aggregate, cement, brick, and other clay products.

Lauderdale.—Lauderdale County Highway Department mined paving gravel.

Lawrence.—Lawrence County Limestone Co. crushed limestone for concrete, roads, and agstone.

Lincoln.—Lincoln County Highway Department crushed limestone for concrete and roads. E. B. Hammons collected a small quantity of gem stones (agate).

London.—Cherokee Stone Co. crushed limestone for concrete and roads. B. C. Wood (Cedar Fork mine) mined barite. Brooks Sand & Gravel Division of Vulcan Materials Co. mined structural sand. Old Hickory Brick Co., Inc. (Greenback mine), mined miscellaneous clay for heavy clay products.

Macon.—Dixon-Stubblefield Limestone Co. (Hillsdale quarry) crushed limestone for concrete, roads, and agstone.

Marion.—Sixty-two coal mines were active; leading producers were Tennessee Products & Chemical Corp. (Reels Cove mine), Thomas Coal Co. (No. 4–51 mine), and Marshall Meeks Co. (G C No. 2 mine). Penn-Dixie Cement Corp. produced portland cement at the Richard City mill. Signal Mountain Portland Cement (Bennetts Lake quarry), Penn-Dixie Cement Corp. (Richard City quarry), and Chattanooga Rock Products (Marion quarry) crushed limestone for cement, concrete, roads, and agstone.

Marshall.—Lewisburg Limestone Co. crushed limestone for concrete, roads, and agstone.

Maury.—Maury County ranked fourth in total value of mineral production. Seven operators produced phosphate rock; leading producers were Monsanto Chemical Co. and Victor Chemical Works. Columbia Rock Products Corp. (Theta Pike mine) crushed limestone for concrete, roads, agstone, and stone sand. Maury Silica Co. mined gravel for miscellaneous uses.

McMinn.—Floyd D. Webb Stone Co. (Webb quarry) and McMinn County Highway Department (Athens quarry) crushed limestone for concrete, roads, and agstone. McMinn Barium Corp. (Niota and Athens mines) and National Lead Co. (Ballard mine) mined barite.

McNairy.—Worsham Bros. mined sand for structural, paving, fill, and other uses and produced gravel for structural, paving, railroad ballast, fill, and miscellaneous uses.

Meigs.—Meigs Stone Co. (Posey quarry) and Ten Mile Stone Co., Inc. (Ten Mile quarry), quarried limestone for riprap, concrete, roads, and agstone.

Monroe.—Creighead Limestone Co. and Monroe County Highway Department crushed limestone for concrete and roads. Vonore Sand Co. mined structural and paving sand. National Lead Co. (Roy mine) mined barite.

Montgomery.—Simpson Stone Co. (Simpson quarry) and Clarksville Stone Co. (Clarksville mine) crushed limestone for concrete, roads, and agstone.

Morgan.—Thirty-three coal mines were active; leading producers were Brushy Mountain Coal Mines (No. 7 mine), C & O Coal Co. (No. 1 mine), and G &F Coal Co., Inc. (G & F Strip mine).

Obion.—Obion County Highway Department mined paving gravel.

Overton.—Seventeen coal mines were active; leading producers were Chilton Coal Co. (No. 1 mine), Crawford Coal Co. (New Baker 8 mine), and Brown Coal Co. (No. 1 mine). Livingston Limestone Co. (South and East quarries) crushed limestone for concrete, roads, and agstone.

Polk.—Polk County ranked second in total value of mineral production. Tennessee Copper Co. mined mixed sulfide ore at the Boyd, Calloway, Eureka, and Mary mines. The ore was concentrated in one flotation mill and yielded copper, iron (pyrite), and zinc concentrates; gold and silver were recovered as byproducts from smelting the copper and zinc concentrates; the iron concentrate was roasted, yielding sulfur dioxide, which was used mainly in manufacturing sulfuric acid, and iron oxide, which was sintered for use by iron and steel plants. The company continued development work at the Cherokee shaft.

Putnam.—Clinchfield Coal Co. (Meadow Creek mine) was the only coal producer. R. E. Poteet and Putnam County Highway Department crushed limestone for concrete, roads, and agstone. Sand, Inc. (Monterey mine), mined structural and paving sand.

Rhea.—Eight coal mines were active; leading producers were A & H Coal Co. (Graham No. 3 mine), Carl Anderson Coal Co. (RC–6 mine), and Cox Coal Co. (No. 2 mine). Rhea County Limestone Co. (Dayton quarry) crushed limestone for concrete, roads, and agstone. W. S. Dickey Clay Mfg. Co. (Graysville mine) mined miscellaneous clay for brick and other heavy clay products.

Roane.—Rockwood Mining Corp. (New Chamberlain mine) mined red iron ore. A. B. Long Quarries, Inc. (Swan Pond quarry), and Lambert Bros. (Rockwood quarry) quarried limestone for riprap, concrete, roads, railroad ballast, lime, stone sand, and agstone. Tennessee Products & Chemical Corp. produced pig iron and sinter at the Rockwood plant.

Robertson.—Porter Brown Limestone Co. (Springfield No. 1 quarry) crushed limestone for concrete, roads, and agstone.

Rutherford.—A & R Stone Co., Inc. (Murfreesboro quarry), and Rutherford County Highway Department crushed limestone for concrete, roads, agstone, and stone sand.

Scott.—Thirty-four coal mines were active; leading producers were Dean Coal Co., Inc. (Dean No. 2 Strip mine), Kee Ann Coal Co. (Straight Fork mine), and Allen Bros. Coal Co. (No. 9 Strip mine).

Sequatchie.—Thirty-nine coal mines were active; Oak Coal Co. (No. 7–204 mine), Tracy Coal Co. (No. 7–217 mine), and A & R Coal Co. (No. 7–24 mine) were the leading producers; Dunlap Stone Co. (Sequatchie quarry) crushed limestone for concrete, roads, and agstone.

Sevier.—Lambert Bros. (Sevierville quarry) and Sevier County Highway Department crushed limestone for concrete and roads. Tortina & Brown (Murphy quarry) quarried dimension limestone for rubble and rough construction uses. Cameron Sand & Gravel Co., Inc. (Boyds Creek and Kodak mines), mined sand for structural and paving uses.

Shelby.—Six mines produced structural, paving, and fill sand and gravel. Leading producers were Cordova Sand & Gravel Co. (Cordova mine) and Marquette Cement Mfg Co. (Tennessee mine). John A. Denies Sons Co. mined miscellaneous clay for brick and other clay products.

Smith.—J. A. Bilbrey (Rome quarry) and Smith County Highway Department crushed limestone for concrete, roads, and agstone.

Stewart.—Sangravl Co., Inc., mined sand and gravel for structural and paving uses at the Dover mine.

Sullivan.—Penn-Dixie Cement Corp. produced masonry and portland cements at the Kingsport mill throughout the year. Lambert Bros. (New Kingsport quarry) and Limestone Products Co. (Rock-way quarry) crushed limestone for concrete, roads, and agstone. General Shale Products Corp. (Kingsport mine) and Penn-Dixie Cement Corp. mined miscellaneous clay for use in cement, brick, and other clay products.

Sumner.—Ralph Rogers & Co., Inc., Pilot Knob Limestone Co., and Sumner County Highway Department crushed limestone for concrete, roads, and agstone.

Tipton.—Owens Sand & Gravel Co. (Covington mine) and Tipton County Highway Department mined sand and gravel for structural uses and paving gravel.

Unicoi.—Brooks Sand-Gravel (Erwin mine) mined structural sand, and paving and railroad ballast gravel. Unicoi County Highway Department (Rex Lewis quarry) crushed limestone for concrete and roads. The Feldspar Corp, ground feldspar at the Erwin grinding plant. Harris Clay Co. ground mica for paint, rubber, and welding rod uses.

Union.—Tennessee Marble Co. (Luttrell No. 3 quarry) quarried dimension marble for rough and dressed building stone. Union County Highway Department (Luttrell and Welch quarries) crushed limestone for concrete and roads.

Van Buren.—Twelve coal mines were active; leading producers were Walden Ridge Coal Co. (Studer Nos. 1 and 2 Strip mines) and Waters Coal & Construction Corp. (No. 2 Strip mine).

Warren.—Warren Limestone Co. crushed limestone for concrete, roads, and agstone. Cumberland Mountain Sand Co. mined structural and paving sand.

Washington.—Washington County Highway Department (Boones Creek, Corby, Dillow, Gray, Taylor Bridge, and Washington quarries) crushed limestone for concrete and roads. General Shale Products Corp. mined miscellaneous clay for brick and other clay products.

Wayne—Hassell & Dowdy Sand & Gravel Co. (Baker mine) mined structural sand and gravel. Universal Limestone Co. (Waynesboro quarry) crushed limestone for concrete, roads, and agstone.

Weakley.—United Clay Mines Corp. (No. 6 mine), Bell Clay Co. (Collins mine), and H. C. Spinks Clay Co., Inc., mined ball clay for whiteware, enameling, floor and wall tile, refractories, and heavy clay products.

White.—Sparta Limestone Co., Farmers Limestone Co., and White County Highway Department crushed limestone for concrete, roads, and agstone. E. B. Hammons collected a small quantity of gem stones (agate).

Williamson.—Monsanto Chemical Co. mined phosphate rock for elemental phosphorus. Lambert Bros. (Franklin quarry) and Williamson County Highway Department (Globe quarry) crushed limestone for concrete, roads, railroad ballast, and agstone.

Wilson.—Marquette Cement Mfg. Co. (Martha quarry), Wilson County Rock Products, Inc. (Lebanon quarry), Lebanon Limestone Co., and Hoover, Inc. (Watertown quarry), crushed limestone for cement, concrete, roads, and agstone.

The Mineral Industry of Texas

This chapter was prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and The University of Texas, Bureau of Economic Geology.

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MARKETS for many of the minerals produced in Texas were nationwide; consequently, developments within the national economy continued to affect major sectors of the State mineral industries in 1961. Markets for natural gas and natural gas liquids were growing. However, petroleum and sulfur industries were faced with diminishing markets due to growing competition from new and expanded sources. Most other Texas mineral producers were also confronted with intense competition in local and regional markets. Nevertheless, total value of Texas mineral production in 1961—$4.2 billion—was slightly more than that of 1960, although it was 7 percent less than the record $4.5 billion value of 1957.

Mineral fuels continued to dominate the State mineral industry, accounting for over 93 percent of the total mineral value. However, restricted level of petroleum activity—101 allowable producing days in 1961, as compared with 171 days in 1957—was a major factor in the reduced industrial growth rate. Internal competition among the mineral fuels for expanding energy-consuming markets remained intense. Output of natural gas liquids increased 7 percent in quantity compared with 1960 output; petroleum and natural gas output gained only 1 percent in the same period.

The modest advance in total mineral value resulted from value gains in mineral fuels, helium, cement, clay, lime, stone, bromine, magnesium chloride, and natural salines, offset in part by value losses in gypsum, salt, sand and gravel, sulfur, and uranium ore.

The oil and gas industry in 1961 was faced with a number of perplexing problems that included the prolonged imbalance of oil supply to demand, generally lower prices for both crude oil and refined products, persistent idle capacity of shut-in wells and oil refineries, gasoline price wars at the retail level, congressional consideration of lower depletion rates for tax allowance, and keener interindustry competition for consuming markets.

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TABLE 1.—Mineral production in Texas[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand 280-pound barrels	865	$2, 613	851	$2, 529
Portland thousand 376-pound barrels	22, 721	73, 964	25, 101	80, 808
Clays[2] thousand short tons	3, 302	5, 058	3, 786	5, 737
Gem stones	(3)	100	(3)	150
Gypsum thousand short tons	1, 131	3, 960	1, 074	3, 846
Helium thousand cubic feet	120, 921	2, 044	173, 066	3, 196
Lime thousand short tons	821	9, 087	880	9, 736
Natural gas million cubic feet	5, 892, 704	665, 876	5, 963, 605	733, 523
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons	2, 880, 906	207, 583	3, 111, 427	214, 279
LP gases do	4, 476, 142	200, 478	4, 768, 222	185, 558
Petroleum (crude) thousand 42-gallon barrels	927, 479	2, 748, 735	[4] 938, 017	[4] 2, 787, 925
Salt thousand short tons	4, 756	18, 222	4, 695	17, 682
Sand and gravel do	29, 844	30, 754	27, 398	30, 691
Stone do	39, 029	45, 088	38, 316	45, 874
Sulfur (Frasch-process) thousand long tons	2, 747	62, 855	2, 730	62, 720
Talc and soapstone short tons	67, 031	336	78, 214	376
Value of items that cannot be disclosed: Asphalt (native), barite (1961), bromine, clay (fuller's earth), coal (lignite), feldspar, graphite, iron ore (usable), magnesium chloride (for metal), magnesium compounds (except for metal), mercury (1960), pumice (1961), sodium sulfate, and uranium ore		49, 666		50, 923
Total Texas[5]		[6] 4, 116, 664		4, 224, 909

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producer).

[2] Excludes certain clays, value included with "Value of items that cannot be disclosed."

[3] Weight not recorded.

[4] Preliminary figures.

[5] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

[6] Revised figure.

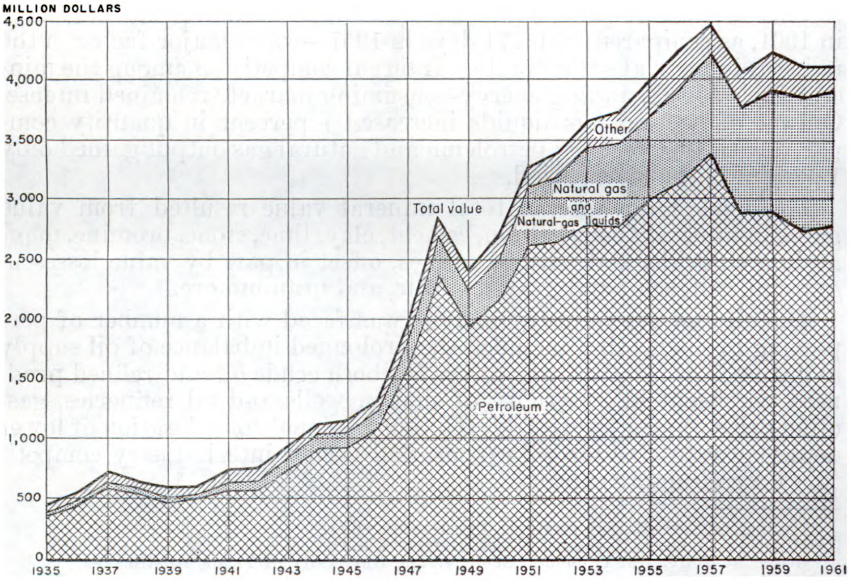

FIGURE 1.—Value of petroleum, natural gas, and natural gas liquids, and total value of mineral production in Texas, 1935–61.

The nonmetals sector of the State mineral industry presented heterogeneous trends among individual commodities. Several major construction materials (cement, clay, and lime) followed the 5-percent advance in construction awards; other construction and chemical materials (gypsum, salt, sand and gravel, stone, and sulfur) failed to match their 1960 outputs.

Primary producers of the light metals, aluminum and magnesium, increased operations because of improved demand for construction and for national defense. Producers of lead and zinc curtailed operations as inventories mounted and prices weakened. Steel-making facilities of the State's two integrated steel mills were expanded as demand for oil tubular goods and structural shapes improved.

The U.S. Department of the Interior implemented its helium conservation program with four contracts to purchase crude helium gas recovered from natural gas destined for consuming markets. The four contractors (Helex Co., Cities Service Helex, Inc., National Helium Corp., and Phillips Petroleum Co.) were to build five plants—three in Kansas and two in Texas.

The world's largest naphthalene plant—annual capacity 100 million pounds—was scheduled to be built at the Port Arthur refinery of Texaco, Inc. Initial production was planned for early 1963. Naphthalene is feedstock for phthalic anhydride used to manufacture flexible plastic film, polyester resins, alkyd paints, and dyes.

Near Houston, a record-size styrene plant (70 million pounds per year) using gasoline fractions as feedstock was put in operation in the third quarter of 1961 by Sinclair-Koppers Chemical Co.

At the Texas City refinery of American Oil Co., a huge pipestill capable of processing 150,000 barrels of crude oil daily into gasoline, kerosine, and feedstock for other refinery units was put on stream late in 1961.

A petrochemical complex costing $100 million, with facilities to produce annually 500 million pounds of ethylene, 42 million gallons of benzene, and 50 million pounds of naphthalene, in addition to propylene, ethylbenzene, cumene, phenol, and acetone, was being built at Chocolate Bayou in Brazoria County by Monsanto Chemical Co. Most of the output was to be used at other Monsanto units.

El Paso Natural Gas Co. and Rexall Drug Co. expanded their petrochemical complex at Odessa by adding a 180-million-pound-per-year olefin plant to be operated by El Paso and a 120-million-pound-per-year polythylene plant to be operated by Rexall. Additional facilities, to be completed by 1965, were planned by the combine.

The world's first seven-zone oil and gas well was being completed in the Blessing field of Matagorda County by Texaco, Inc. Texas already had a record of three six-zone completions: A six gas-zone well in the North La Ward field of Jackson County by Mid-Continent Oil Co.; a combination five gas-one oil-zone well in the McFadden field of Victoria County, also by Mid-Continent Oil Co.; and a six oil-zone well by Humble Oil & Refining Co. on the King Ranch in Kleberg County. The State's deepest gas well, an Ellenburger gas discovery in the Delaware Basin, was completed in Reeves County by Gulf Oil Corp.

Part of the magnesium facilities of The Dow Chemical Co. plant B were being reconditioned for resumption of production by January 2, 1962, because of depleted metal inventories and improved sales.

The first saline water conversion plant to be built by the U.S. Government under the Saline Water Conversion Program was completed on April 7, 1961, at Freeport in Brazoria County; plant tests started May 8, and the first potable water was produced on May 12. Capacity operation of the 1-million-gallon-per-day facility began on June 21.

In summary, the mineral economy of Texas continued its relatively static pattern of the last few years. Crude oil output from regulated wells was further reduced and oil from competing domestic and foreign sources replaced Texas oil in the market. Competition among types of fuels gained in significance. As oil replaced coal in some energy markets, natural gas and natural gas liquids were replacing oil in certain markets.

Even though the oil industry had been in a recession period since 1957, other segments of the mineral industry experienced steady growth. Except for Frasch sulfur, production of all other major nonmetals increased.

Employment and Injuries.—Employment in nonagricultural industries of Texas increased from 2,488,200 in January to 2,559,400 workers in December, with slight declines in February and September, according to the Texas Employment Commission. Employment in mining industries, including petroleum and natural gas, averaged 119,400 workers, compared with the 1960 average of 122,800 workers, a 3-percent decline. Petroleum and natural gas employment—accounting for 94 percent of the mining sector—remained static through the first quarter, improved gradually through August, then decreased so that December employment approximated that of January. Manufacturing employment averaged 483,200 workers, about 1 percent under the 1960 average. Employment in the primary metals, stone, clay, glass, chemical, and petroleum refining industries represented about 27 percent of total manufacturing and averaged 131, 800 workers in 1961, a decline of 2,500 workers from the 1960 average of 134,300.

TABLE 2.—Employment data in mining and related industries

Industry	Employment		Weekly hours worked		Weekly earnings	
	1960[1]	1961	1960	1961	1960	1961
Manufacturing	489,500	483,200	41.1	41.1	$89.19	$92.48
Primary metals	24,500	23,700	38.9	40.4	100.75	109.48
Chemicals	44,800	44,800	41.1	40.8	121.66	125.26
Petroleum and coal products	41,600	39,800	40.2	40.8	121.00	129.34
Machinery (oil field)	39,800	39,200	40.2	41.8	100.10	106.17
Transportation equipment	53,100	50,900	40.4	40.6	114.33	110.03
Nonmanufacturing	2,042,200	2,038,300	--------	--------	--------	--------
Mining	122,800	119,400	42.1	42.1	106.93	111.57
Crude petroleum	[2] 116,000	[2] 112,800	42.0	42.1	108.78	113.67
Other mining	6,800	6,600	40.0	39.9	114.80	118.10
Construction	161,100	160,200	--------	--------	--------	--------

[1] Revised figures.

[2] Includes natural gas.

Source: Texas Employment Commission in cooperation with U.S. Bureau of Labor Statistics.

Wages in the mineral industries in 1961 amounted to $14.8 billion, of which $7 billion or 47 percent represented mining payrolls, including petroleum and natural gas industries, and $7.8 billion represented payrolls in chemical, glass, primary metals, and petroleum refining industries.

There were 62 fatal and 4,659 lost-time injuries in the mineral industries and 32 fatal and 2,192 lost-time injuries in the paper, chemical products, petroleum refining, rubber and plastics, stone and clay, and primary metals industries of the manufacturing groups in 1961, according to the Industrial Accident Board of Texas. Major agency factors responsible for fatal injuries (in percentages) were elevators and conveyors, 16; vehicles, 15; working surfaces, 13; and unclassified, 45. Factors responsible for nonfatal injuries were elevators and conveyors, 43; working surfaces, 13; and unclassified, 25. Fractures were responsible for 6 percent of the fatalities; burns, 13 percent; cuts and lacerations, 5 percent; crushing and shock, 56 percent; and unclassified, 18 percent. Fractures were responsible for 33 percent of lost-time injuries; cuts and lacerations, for 27 percent; strain and sprain, for 22 percent; and unclassified, 9 percent.

Government Programs.—The Government's first saline water conversion plant, at Freeport in Brazoria County, began operating at capacity on June 21.

The U.S. Army Corps of Engineers had seven dams in various stages of construction: Canyon on Guadalupe River, Waco on Bosque River, Proctor on Leon River, Navarro Mills on Richland Creek, McGee Bend on Angelina River, Somerville on Yegua Creek, and Stillhouse Hollow on Lampasas River. The Federal Bureau of Reclamation requested bids for construction of the $96 million Sanford Dam on the Canadian River.

A comprehensive plan for meeting 1980 projected water requirements of Texas was submitted to the 57th State Legislature by the Texas Water Commission. This study was in conjunction with the U.S. Study Commission-Texas and associated river basin commissions.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The mineral fuels industry of Texas, supplying more than 50 percent of the Nation's fuel requirements, faced a paradoxical situation in attempting to reduce the imbalance between supply and demand of crude oil while expanding the natural gas and natural gas liquid segments. Another serious and persistent problem was that of idle crude oil capacity from both prorated and unconnected wells—nearly 2 million barrels a day. Authoritative sources believed that the slowdown in growth rate of demand for crude oil and some of its refined products would continue for several more years.

Prices of some crudes were lowered 10 to 15 cents a barrel in the third quarter of 1961, as demand failed to improve. Crude stocks totaled more than 105 million barrels during the last three quarters of the year. Prices of refined products such as gasoline and kerosine fluctuated between price-war levels and normal levels.

New petrochemical plants and expansions to existing plants strengthened the State's position as a major producer in this industry. Part of the new facilities produced naphthalene and benzene from a petroleum base. Increased quantities of these products were to be used to manufacture plastic film, polyester resins, surface coatings, and dyes. Napthalene and benzene, normally byproducts of coke manufacture, were in short supply owing to the extended steel strike in 1960 and to the steel industry's low operating rate in 1961. Other expanded facilities increased output of ethylene, propylene, acetylene, butadiene, and styrene—all basic raw materials used in plastics, paints, floor coverings, synthetic fibers, rubbers, and detergents.

Carbon Black.—Output of carbon black declined 1 percent in quantity and value, compared with 1960. Consumption of natural gas as a source of carbon black declined 25 percent from that of 1960 and was 38 percent less than in 1957. Nearly 80 percent of the carbon black was produced by 11 plants using petroleum distillate, and the remainder was produced by 3 additional plants using both distillate and natural gas; in 1957 50 percent was recovered from distillate. About 87 billion cubic feet of natural gas was consumed for an average yield of 2.5 pounds of channel black per thousand cubic feet of gas, compared with a yield of 3.75 pounds per thousand cubic feet in 1960. Furnace plants consumed 183 million gallons of liquid hydrocarbons for an average yield of 4.60 pounds of furnace black per thousand gallons of liquid; average yield in 1960 was 4.32 pounds per thousand gallons. Three furnace plants consumed an additional 12.5 million cubic feet of natural gas. Average unit value was 7.14 cents per pound for furnace black and 10.58 cents per pound for channel black. Consumption patterns remained essentially the same as in 1960 with the rubber, paint, and ink industries as the major consumers, followed by the plastic, chemical, and paper industries.

Coal (Lignite).—Extensive deposits of lignite (brown coal), occurring in the Eocene Wilcox and Claiborne groups of the Coastal Plains of Texas, were mined by open-pit methods in Milam and Harrison Counties by two producers. All production was captive, with output approximating that of 1960. Lignite was used principally as fuel for electric power generation and as raw material for manufacturing activated carbon.

Helium.—The Helium Act (Public Law 86–777), authorizing the Secretary of the Interior to contract for helium purchases up to $47.5 million a year, was implemented during 1961 by contractual agreements with four private firms that were to build five helium recovery plants—two in Texas and three in Kansas. The plants would process natural gas destined for consuming markets to recover an estimated 62.5 billion cubic feet of helium over a 22-year period. The crude helium (60- to 70-percent pure) was to be transmitted by Government pipeline and stored in the Government Cliffside gasfield, near Amarillo, for ultimate use.

Production at the Amarillo and Exell helium plants of the Bureau of Mines rose 23 percent above 1960 output, and shipments increased 43 percent. The price of helium was raised from $15.50 and $19.00 per thousand cubic feet (f.o.b. plant) for Federal and civilian purchasers, respectively, to $35.00 per thousand cubic feet for all purchasers on November 18, 1961, by regulations governing sale of helium issued pursuant to the Helium Act. Federal agencies such as Air Force, Navy, and Atomic Energy Commission, remained the principal purchasers and accounted for more than 75 percent of the demand; civilian purchasers comprised the remainder. Helium is used in research and in missile and space vehicle programs. Construction of a 600-gallon-per-day liquid helium plant was begun by Linde Co. to supply a small, but growing need for liquid helium in research.

Natural Gas.—The State natural gas industry made further strides by supplying more fuel- and chemical-consuming markets in many sections of the Nation, by installing major pipelines to supply the new markets at reduced cost through automated transmission controls and improved pipeline construction methods, and by increasing storage facilities at key consuming areas to meet both seasonal and increased demands. Underground gas-storage capacity was increased 18 percent to 70.6 trillion cubic feet, according to the American Gas Association.

Texas remained the ranking gas-producing State. It contributed 45 percent of marketed production, and contained the major gas reserves—45 percent of the national total. According to the Railroad Commission of Texas, 2,511 billion cubic feet of marketed gas was consumed in Texas, and 2,982 billion cubic feet was shipped out of State. At the end of 1961, there were 28,048 producing gas wells that yielded 5,127 billion cubic feet (75 percent) of gas and 196,396 oil wells that yielded 1,667 billion cubic feet (25 percent) of casinghead gas.

TABLE 3.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)	Year	Million cubic feet	Value (thousands)
1952–56 (average)	4,562,576	$358,119	1959	5,718,993	$617,651
1957	5,156,215	500,153	1960	5,892,704	665,876
1958	5,178,073	517,807	1961	5,963,605	733,523

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

The estimated natural gas reserve increased slightly, totaling 119,839 billion cubic feet at yearend, according to the American Gas Association. This amounted to 20 cubic feet of gas reserve for each cubic foot produced. Exploratory drilling added 3,141 billion cubic feet through new discoveries; extensions and revisions added another 3,139 billion cubic feet to the gas reserve.

The oil and gas industry completed 942 exploratory and 2,213 development gas wells and drilled 5,501 dry holes, according to the Railroad Commission of Texas. The State's deepest gas well, producing from a zone from 17,180 to 17,200 feet deep was completed in November by Gulf Oil Corp.

Natural Gas Liquids.—The natural gas liquids industry continued to lead the Nation with a record output of 7.9 billion gallons, up 7 percent from 1960 and 16 percent more than in 1957. As in 1960, LP gases represented 61 percent of the recovered liquids; natural gasoline and cycle products represented the remainder. Though the industry expanded in 1961, and future demands appeared promising, it was plagued with an oversupply of LP gases, insufficient storage capacity, and lower commodity prices. Part of the imbalance resulted from competition with natural gas for industrial and residential air-conditioning markets. However, the natural gas liquids industry continued to expand recovery facilities with 14 new gasoline plants having a total processing capacity of 628 million cubic feet per day. The more important installations were the 150-million-cubic-foot-per-day Port Arthur plant of Port Gas Processing Co. in Jefferson County, the 100-million-cubic-foot-per-day N. E. Thompsonville plant of Atlantic Refining Co. in Callahan County, and the 95-million-cubic-foot-per-day Leabo plant of Tenneco Oil Co. in Matagorda County. Shell Oil Co. began building a 30-million-cubic-foot-per day gasoline and a 130-ton-per-day sulfur recovery plant at Bryans Mill. In addition, 13 gasoline plants were under construction with an estimated processing capacity totaling 350 million cubic feet per day. Three gasoline plants, having a combined capacity of 181 million cubic feet per day, were inactive primarily owing to depletion of the natural gas supply. There were 249 natural gasoline plants recovering liquids, compared with 226 natural gasoline plants, 26 cycling plants, and 16 pressure maintenance plants in 1960.

TABLE 4.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	2,804,896	$202,484	3,080,039	$109,768	5,884,935	$312,252
1957	2,944,381	201,423	3,831,664	147,618	6,776,045	349,041
1958	2,871,589	204,501	3,786,575	151,896	6,658,164	356,397
1959	2,790,155	209,238	4,353,368	181,148	7,143,523	390,386
1960	2,880,906	207,583	4,476,142	200,478	7,357,048	408,061
1961	3,111,427	214,279	4,768,222	185,558	7,879,649	399,837

According to the American Gas Association, the estimated proved recoverable reserve of natural gas liquids at yearend was 3,755 million barrels—53 percent of the U.S. total. Exploratory drilling added 53 million barrels to the recoverable reserve; development drilling added 347 million barrels by extensions and revisions.

Underground storage capacity for natural gas liquids was 48.6 million barrels, according to Oil & Gas Journal, with 9 new caverns completed and 7 caverns under construction. About 66 percent of the capacity was in Gulf Coast salt domes, about 27 percent in inland salt beds, and the remainder in gas sands.

Petroleum.—The crude oil industry was confronted with the situation of being its own competitor in major energy markets. Many producers were dual suppliers (of petroleum and casinghead gas) for identical markets. Table 4 shows the relationship and the relatively rapid growth of the gas segment. Thus, while the industry increased oil output less than 70 percent in the period 1940–50, gas output (of which the industry contributed about one-fourth as casinghead) almost trebled that of 1940. By 1961, the gas increase was five times that of oil, whose output had declined. Also, while gas accounted for but 27 percent of total oil and gas produced in 1940, it exceeded oil in terms of oil equivalent in 1961—51 percent gas to 49 percent oil.

TABLE 5.—Crude oil-natural gas relationship, 1940–61

Year	Oil production		Gas production			
	Million barrels	Percent change	Million cubic feet	Oil equivalent [1]	Percent change	Percent total
1940	493	----------	1,064,000	178	----------	27
1950	830	+68	3,126,000	521	193	39
1955	1,053	114	4,731,000	789	343	43
1961	938	90	5,964,000	994	458	51

[1] Oil equivalent represents 6,000 cu ft of gas per barrel of oil.

TABLE 6.—Crude petroleum production
(Thousand barrels and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952-56 (average)	1,035,337	$2,861,761	1959	971,978	$2,893,146
1957	1,073,867	3,338,119	1960	927,479	2,748,735
1958	940,166	2,872,389	1961 [1]	938,017	2,787,925

[1] Preliminary figures.

TABLE 7.—Crude petroleum production, indicated demand, and stocks in 1961, by months
(Thousand barrels)

Month	Production	Indicated demand	Stocks originating in Texas	Month	Production	Indicated demand	Stocks originating in Texas
January	80,378	83,755	97,236	September	73,799	71,947	107,923
February	73,493	76,156	94,573	October	77,510	79,722	105,711
March	87,011	80,336	101,248	November	75,646	75,878	105,479
April	80,416	75,970	105,694	December	81,771	80,627	106,623
May	78,041	75,704	108,031				
June	75,317	73,273	110,075	Total:			
July	76,502	78,870	107,707	1961 [1]	938,017	932,007	----------
August	78,133	79,769	106,071	1960	927,479	937,998	----------

[1] Preliminary figures.

Crude oil production amounted to 938 million barrels from 196,396 oil wells, compared with 1960 production of 927.5 million barrels from 192,627 oil wells. Daily average production of crude oil was 2,569,918 barrels or 13.1 barrels per well, compared with 13.2 barrels per well in 1960. Average indicated daily demand for crude oil was 2,553,440 barrels, about 3 percent more than in 1960.

The estimated proved recoverable reserve of crude oil amounted to 14,850 million barrels as of January 1, 1962, according to the American Petroleum Institute, an increase of 92 million barrels over January 1, 1961. The reserve was equivalent to 16 barrels of recoverable crude oil underground for each barrel of oil produced in 1961. Exploratory drilling added 102 million barrels to the proved oil reserve; development drilling added 888 million barrels. Texas had 47 percent of total U.S. oil reserves and 48 percent of total liquid fuel reserves, including natural gas liquids.

Texas refineries had a combined average daily crude capacity of 2.6 million barrels. Operating at about 85 percent of capacity, they charged 799 million barrels of crude oil to stills; this amounted to a daily average run of 2.2 million barrels—down 1,750 barrels daily from 1960 runs.

Noteworthy expansions were completed at Texas refineries. A multimillion dollar expansion made the Texas City refinery of American Oil Co. one of the most modern in the world and the fifth largest refinery in the State. New facilities included the world's largest pipestill with a daily capacity of 150,000 barrels of crude, a 14,600-barrel-a-day alkylation unit, and a 95,000-barrel-per-day catalytic cracker. Desalting, stripping, treating and caustic regeneration facilities were included in the new crude oil unit. Crown Central Petroleum Corp. added a Udex unit to its Pasadena refinery to recover benzene, toluene, and xylene from its catalytic reformer unit. Gulf Oil Corp. added a 12,000-barrel-a-day delayed-coker unit and a 13,000-barrel-per-day lube finishing unit, and also increased catalytic cracking to 105,000 barrels per day at its Port Arthur refinery, the third largest refinery in Texas. Humble Oil & Refining Co. almost doubled its Baytown refinery benzene and toluene capacities to 55 million gallons each, per year, and increased crude oil capacity to 302,000 barrels per day to keep it the State's largest refinery. The company also raised catalytic cracking fresh-feed capacity to 154,000 barrels per day, recycle capacity to 51,000 barrels a day, and reforming capacity to 48,000 barrels a day. New and expanded facilities at the Beaumont refinery of Mobil Oil Co. included a 20,000-barrel-per-day delayed-

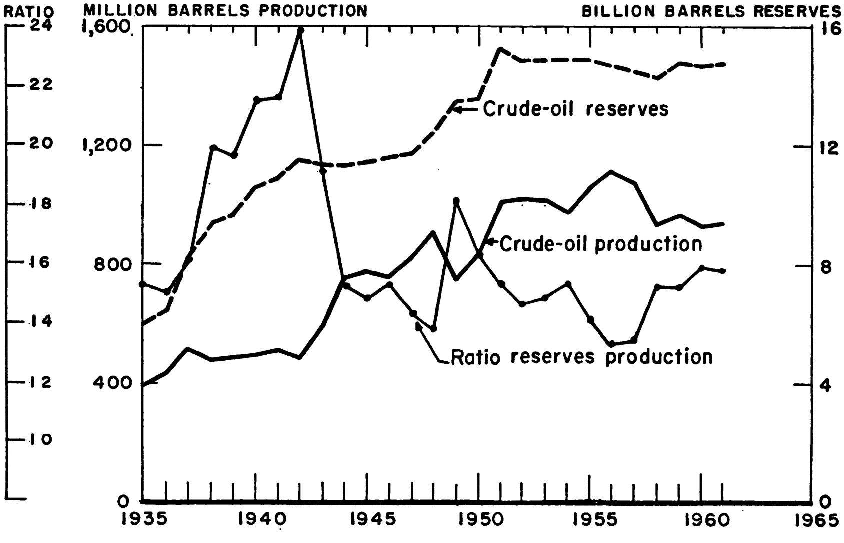

FIGURE 2.—Ratio of proved crude reserves to production, 1935–61.

TABLE 8.—Production of crude petroleum, by districts and fields

(Thousand barrels)

District and field [1]	1960	1961 [2]
Gulf Coast:		
Amelia	(3)	1,494
Anahuac	3,491	3,385
Barbers Hill	1,339	1,153
Chocolate Bayou	4,057	3,752
Conroe	6,001	5,749
Dickinson-Gillock	3,077	3,336
Fannett	1,731	1,764
Goose Creek	2,468	2,296
Greta	1,471	1,365
Hankamer	1,203	1,358
Hastings	7,741	7,671
Heyser	1,300	1,327
High Island	4,600	5,119
Hull	2,632	2,647
Humble	1,184	1,260
Liberty, South	3,560	3,068
Lolita	1,505	1,388
Manvel	1,055	1,032
Markham	1,356	1,204
O'Connor, Tom	7,697	8,533
Old Ocean	3,709	3,923
Oyster Bayou	1,822	1,773
Pierce Junction	2,962	2,654
Raccoon Bend	1,293	1,412
Refugio-Fox	1,595	1,491
Thompson	5,186	5,293
Tomball	1,523	1,533
Village Mills	1,578	1,757
Webster	5,801	5,628
West Columbia	2,942	2,780
West Ranch	4,137	5,607
Withers-Magnet	1,629	1,589
Other Gulf Coast	75,523	74,880
Total Gulf Coast	167,168	169,221
East Texas:		
East Texas Proper	48,704	48,583
Hawkins	9,174	8,909
New Hope	1,533	1,318
Quitman	2,909	3,248
Talco	4,109	4,321
Van	4,885	4,798
Other East Texas	29,910	31,604
Total East Texas	101,224	102,781
Central Texas:		
Big Foot	1,435	1,313
Charlotte	1,255	1,172
Darst Creek	3,674	3,493
Luling	1,568	1.445
Other Central Texas	8,538	8,628
Total Central Texas	16,470	16,051
South Texas:		
Fulton Beach	2,265	2,253
Hoffman	1,240	1,226
Kelsey	2,295	2,738
Mirando	4,763	4,676
Mustang Island	1,515	1,537
Plymouth	6,385	5,811
Portilla	2,085	2,239
Seeligson	8,050	15,027
Sun	1,941	2,151
Taft	1,929	1,484
White Point	2,109	2,137
Willamar, West	1,346	1,412
Other South Texas	32,401	25,966
Total South Texas	68,324	68,657
North Texas	117,302	115,070
Panhandle	38,570	38,772
West Texas:		
Abell	1,251	1,346
Adair	1,886	1,851
Andector	3,254	3,270
Anton Irish-Anton	1,789	1,750
Bakke		4,932
Benedum	1,282	1,164
Block 31	5,787	5,763
Cedar Lake	1,152	1,348
Cogdell	5,281	5,211
Cowden	11,480	12,435
Diamond M	6,123	6,176
Dollarhide	3,018	2,735
Dune		1,501
Embar	1,290	1,128
Emma	2,749	2,737
Fort Chadbourne	2,745	2,656
Foster	2,874	2,888
Fuhrman	3,743	3,463
Fullerton	5,834	5,977
Garza	1,766	1,687
Goldsmith	22,253	21,319
Good	1,549	1,393
Harper	1,497	1,256
Headlee	4,830	5,040
Hendrick	1,665	1,522
Howard-Glasscock	6,167	6,583
Iatan—East and North	1,788	1,779
Jameson	2,560	2,351
Jordan	2,648	2,561
Kelly Snyder	17,557	16,924
Kermit	5,413	5,338
Keystone	5,679	5,720
Levelland	5,842	5,907
McCamey	1,889	1,894
McElroy	8,882	8,347
McFarland	1,534	1,362
Mabee	1,533	1,701
Magutex	2,011	2,064
Martin	1,234	1,185
Means	4,046	4,124
Midland Farms	6,076	6,169
Pegasus	4,047	4,896
Penwell	3,018	2,863
Prentice	3,470	3.265
Robertson	3,179	3,436
Russell	4,903	5,320
Salt Creek	3,333	3,205
Sand Hills	4,788	5,265
Seminole	3,261	3,233
Shafter Lake	2,132	2,048
Sharon Ridge	3,146	3,450
Slaughter	8,188	8,211
Sprayberry Trend	10,162	9,902
Tippett	1,380	1,289
Todd	1,414	1,354
Triple N	1,332	1,219
TXL	3,870	3,948
University	3,602	3,872
Vealmoor-East	1,780	1,682
Waddell	2,669	2,809
Ward-Estes	19,186	19,728
Wasson	12,005	12,041
Welch	1,909	1,906
Westbrook	1,418	1,322
Wilshire	1,320	1,206
World	1,702	1,665
Yates	5,495	5,292
Other West Texas	135,755	138,981
Total West Texas	418,421	427,465
Total Texas	927,479	938,017

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[1] Texas Railroad Commission districts.
[2] Preliminary figures.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Other" fields.

coker unit and increased catalytic cracking fresh feed to 83,000 barrels a day and recycle capacity to 23,000 barrels a day. This refinery was the fourth largest in Texas. Sinclair Refining Co. replaced a vacuum distillation unit with a 60,000-barrel-a-day crude still and added a 6,800-barrel-a-day lube unit. Texaco, Inc., increased its Port Arthur refinery crude oil capacity to 285,000 barrels a day and added a 12,000-barrel-a-day kerosine hydrotreater. Phillips Petroleum Co. increased the crude oil capacity of its refinery in Hutchinson County to 85,000 barrel a day, catalytic cracking (fresh-feed) capacity to 55,000 barrels a day, and alkylation production to 9,000 barrels a day.

Petrochemicals.—The petrochemical industry, one of the Nation's most dynamic industries within the past two decades, was concentrated along the Gulf Coast, principally in Texas. The concentration resulted from an adequate supply of raw materials, readily available fuel, large underground storage facilities, ample transportation by rail, barge, truck, pipelines, or ocean freight, suitable climatic con-

TABLE 9.—Petroleum daily average production and runs to stills

(Thousand barrels)

Month	1960		1961	
	Crude production	Runs to stills	Crude production	Runs to stills
January	2,714	2,238	2,593	2,278
February	2,741	2,193	2,625	2,343
March	2,691	2,150	2,807	2,240
April	2,597	2,168	2,680	2,194
May	2,450	2,181	2,518	2,209
June	2,502	2,271	2,511	2,094
July	2,432	2,282	2,468	2,206
August	2,454	2,195	2,520	2,276
September	2,501	2,146	2,460	1,916
October	2,430	2,140	2,500	2,224
November	2,527	2,156	2,522	2,163
December	2,582	2,168	2,638	2,124

TABLE 10.—Runs to stills and output of refineries in 1961, by months

(Thousand barrels)

Month	Runs			Output					
	Crude	Products	Rerun	Gasoline	Kerosine	Fuel oil		Jet fuel	Miscellaneous
						Distillate	Residual		
January	70,628	6,742	−2,547	37,098	5,547	17,405	5,100	2,054	7,619
February	65,605	5,549	−1,254	32,686	4,332	18,707	4,871	2,067	7,237
March	69,456	6,151	−1,918	36,924	4,563	16,473	4,811	2,925	7,993
April	65,813	5,936	−2,914	35,117	3,398	14,828	4,513	2,362	8,617
May	68,470	6,649	−3,280	36,706	2,980	15,432	4,906	2,571	9,244
June	62,819	6,761	−2,329	34,869	3,232	14,711	3,660	1,962	8,817
July	68,391	6,679	−1,659	38,142	3,709	16,735	4,394	2,222	8,209
August	70,570	6,350	−18	38,792	3,708	18,210	4,838	2,569	8,785
September	57,469	5,784	−3,929	30,144	3,446	13,298	3,269	1,979	7,188
October	68,937	6,949	−1,188	37,151	4,490	18,190	4,413	2,248	8,206
November	64,897	7,414	−910	36,565	4,188	16,598	3,718	2,388	7,944
December	65,859	6,948	1,157	36,633	4,187	18,093	4,757	2,290	8,004
Total:									
1961	798,914	77,912	−20,789	430,827	47,780	198,680	53,250	27,637	97,863
1960	801,775	77,033	−23,413	437,812	47,847	185,901	58,629	27,460	97,746

TABLE 11.—Stocks of crude petroleum at refineries, tank farms, and gathering systems in 1961, by months

(Thousand barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January	14,299	62,610	7,484	84,393
February	14,203	60,878	7,439	82,520
March	15,508	63,851	7,549	86,908
April	17,104	67,760	7,699	92,563
May	16,471	69,940	7,404	93,815
June	15,720	72,930	7,639	96,289
July	15,859	71,218	7,634	94,711
August	15,339	67,695	7,174	90,208
September	16,225	69,498	7,224	92,947
October	15,311	68,732	6,884	90,927
November	15,230	67,013	7,784	90,027
December	15,012	69,573	7,884	92,469

TABLE 12.—Stocks of refined products by refineries with plants and pipelines in 1961, by months

(Thousand barrels)

Month	Gasoline[1]	Kerosine	Fuel oil		Jet fuel	Natural gas liquids	Miscellaneous products
			Distillate	Residual			
January	40,169	3,551	10,695	8,429	1,567	489	22,140
February	42,737	3,037	9,822	8,116	1,689	566	22,248
March	40,330	3,298	8,875	6,993	2,074	569	22,404
April	39,031	3,794	9,370	7,750	2,107	612	24,035
May	36,981	3,829	11,563	7,724	2,127	1,005	25,976
June	36,394	4,642	15,738	8,275	2,198	914	26,827
July	35,322	4,692	17,585	8,203	2,421	918	26,466
August	33,295	4,187	17,248	8,284	2,373	923	24,916
September	29,369	4,089	17,209	7,704	2,026	1,017	26,155
October	32,234	4,126	18,076	8,189	1,829	941	25,040
November	31,818	3,986	18,553	7,491	1,813	816	25,096
December	32,867	3,722	15,978	7,667	1,933	966	23,103

[1] Includes naptha.

ditions, and an adequate labor supply. The industry represented over $4 billion in capital investment, provided nearly 45,000 jobs that generated over $250 million in annual earnings, contributed significantly to State income through taxes, and consumed substantial volumes of mineral raw materials produced in the State. There were about 700 chemical plants in Texas, according to the 1958 census of the U.S. Department of Commerce, mostly as industrial complexes in metropolitan areas such as the Beaumont-Orange-Port Arthur area; the Houston-Texas City-Freeport area; and the Corpus Christi, Brownsville, and Odessa areas.

An investment survey of the petrochemical industry by the Manufacturing Chemists Association showed a cash outlay of $713 million in new plants and facilities in 1961. This was 23 percent of the total $3.1 billion spent nationwide for chemical facilities and 75 percent of the $951 million invested in the south central States of Arkansas, Louisiana, Oklahoma, and Texas. Organic chemical facilities cost nearly $365 million; plastics and resins, nearly $194 million; inorganic chemicals, $60 million; and synthetic rubbers and fibers, fertilizers, and miscellaneous products, $94 million.

Pipelines.—More than 66,000 miles of pipelines laid in Texas—according to the 1961 Oil & Gas Report of the Railroad Commission of Texas—represented a 30-percent increase over total pipeline mileage in 1960 and included 36,614 miles of trunk lines and 29,436 miles of gathering lines. One major pipeline construction project was an 1,100-miles LP gas line from Mont Belvieu, Tex., to near Raleigh, N.C., by Dixie Pipeline Co. A parallel products line was proposed for Federal Power Commission approval by Trans-Southern Pipeline Corp., a combine of 10 major oil and pipeline companies. Natural Gas Pipeline Co. announced that it would build about 133 miles of pipeline in Refugio, Wharton, Victoria, Panola, and Harrison Counties to increase installed facilities by 60 million cubic feet daily. Plans to build 258 miles of 6- and 8-inch products line to transport 17,000 barrels a day of refined products from its Baytown refinery to the San Antonio and Austin areas were reported by Humble Pipe Line Co., affiliate of Humble Oil & Refining Co. A crude oil and condensate line, to serve parts of 13 oilfields in the Texas and Oklahoma Panhandles, and to handle about 6,000 barrels daily for the Borger refinery was being built by Phillips Pipe Line Co. A 133-mile, 6-inch line to transport 10,000 barrels of refined products daily was being built from the Dallas-Fort Worth market area to the Mount Pleasant refinery of American Petrofina Co. of Texas. The Dow Chemical Co. built a 51-mile pipeline from Sheridan to Markham to deliver LP gas to its chemical plants at Freeport.

NONMETALS

During the last decade, output of all major nonmetals (excluding fuels) except Frasch sulfur increased. From 1952 to 1961, total produced value of nonmetallic commodities increased almost 50 percent, even though the State economy and the mineral industry were affected by three recessions. The value of lime, stone, and salt produced has more than doubled since 1952. In addition, value of cement and sand and gravel production rose by 1½ times over the 10-year period.

Barite.—For the first time in history, crude barite was produced in the State, as Continental Minerals began operation in Culberson County. International Minerals & Chemical Corp. began operating a new barite processing plant at Houston. The plant cost $500,000 and had an initial capacity of more than 125,000 tons a year. Continuing a recent trend, the quantity of drilling mud shipped in liquid form increased.

Bromine.—Bromine production increased 10 percent in both tonnage and value, thus reversing a downward trend that began in 1958 after a record peak in 1957. Bromine is used in tetraethyl lead fluid for motor fuels.

Cement.—Value of cement shipped during the year was second only to the record output reported in 1959. Sixteen plants, with combined total annual capacity of 38.8 million barrels, operated at about 65 percent capacity—up from the rate of 59 percent of combined capacity in 1960. Average price fluctuated between $3.20 and $3.35. An overall excess capacity built up over a long period of intense construction did not deter companies from expanding some facilities and constructing new plants. McDonough Co. announced plans to build a $5 million wet-process cement manufacturing plant at Houston. The plant was to have an annual capacity of 1.5 million barrels. Scheduled for completion late in 1962, the facility was to operate as The Gulf Coast Portland Cement Co. Annual capacity of the Universal Atlas Cement Corp. Waco plant was doubled.

TABLE 13.—Shipments of portland cement to Texas consumers

Year	Texas (thousand barrels)	Change, percent	
		In Texas	In United States
1952–56 (average)	18,869		
1957	18,891	−10	−6
1958	22,323	+18	+6
1959	23,884	+7	+9
1960	20,195	−15	−7
1961	21,566	+7	+3

TABLE 14.—Portland cement produced and shipped

(Thousand barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1952–56 (average)	22,138	22,038	$58,221
1957	21,845	21,547	66,201
1958	25,465	25,209	77,186
1959	27,111	27,215	$85,022
1960	23,190	22,721	73,964
1961	24,889	25,101	80,808

Clays.—Value and quantity of clay sold and used increased 13 percent and 15 percent, respectively. However, part of the increase resulted from a statistical adjustment in reporting 1.1 million tons of clay that was used in cement.

Bentonitic clay accounted for 3 percent of the quantity and 16 percent of the value of clays sold or used. This clay was used for filtering and decolorizing, 62 percent; drilling muds, 25 percent; carrier for insecticides and fungicides, 4 percent; in foundries and steelworks, 2 percent; and unspecified uses, 7 percent.

Consumption of fire clay was about 5 percent less than in 1960. About 52 percent of the fire clay was used in making heavy clay products. The remainder was consumed in manufacturing firebrick (47 percent) and pottery (1 percent).

Miscellaneous clay, excluding clay used for cement, increased 13 percent in quantity and 21 percent in value over that of 1960, reflecting an increase in average unit value from $1.03 to $1.10 per short ton. Continuing an upward trend in clay consumption, the 8 lightweight aggregate plants in the State used over 42 percent of the total miscellaneous clay. About 1 million tons of clay was used in the manufacture of heavy clay products.

Feldspar.—A small quantity of feldspar was produced in Llano County. Value of feldspar production had declined 95 percent in the last decade.

TABLE 15.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Bentonite		Fire clay		Miscellaneous clay		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1952–56 (average)	100	$1,040	397	$1,249	2,065	$2,335	2,562	$4,624
1957	127	963	454	1,057	2,411	2,913	2,992	4,933
1958	121	889	501	1,135	3,097	3,400	3,719	5,424
1959	133	947	722	1,596	3,015	3,160	3,870	5,703
1960	116	873	715	1,668	2,471	2,517	3,302	5,058
1961	122	900	676	1,660	2,988	3,177	3,786	5,737

[1] Incomplete total, excludes fuller's earth.

Gem Stones.—A wide variety of gem stones valued at an estimated $150,000 was collected during the year. Agate, amethyst, apatite, chrysocolla, cinnabar, garnet, obsidian, opal, fluorite, and petrified wood were the principal gem materials found.

Graphite.—Value of graphite mined from open pits and processed in the mill of Southwestern Graphite Co. near Burnet, approximated that of 1960.

Gypsum.—In El Paso, Texas Gypsum Co. began operating its $1 million wallboard and plaster plant; daily consumption of crude gypsum was 70 tons. Raw material for the plant was produced at company mines near Carlsbad, N. Mex. Although construction increased 5 percent over 1960, gypsum production declined 5 percent. Use of stockpiled gypsum accounted for reduced production.

TABLE 16.—Crude gypsum mined

Year	Short tons	Value	Year	Short tons	Value
1952–56 (average)	1,162,691	$3,431,708	1959	1,351,060	$4,770,228
1957	1,043,236	3,343,217	1960	1,131,034	3,960,361
1958	1,240,050	4,120,311	1961	1,073,671	3,845,941

Lime.—A record production of 880,000 tons of lime valued at $9.7 million was reported. Part of the 7-percent increase in both quantity and value resulted from expanded statistical coverage of the paper industry. Chemical and industrial uses of lime consumed 77 percent of total output; virtually all the rest was used in construction. A change had occurred in the use pattern of lime during the past few years. In 1957, more than 90 percent of the output was sold for chemical and industrial uses; use of lime in construction was only 10 percent of the 1957 total and more than 23 percent of the 1961 total. The chief reason for the increased proportion of lime used in construction was its greater use in soil stabilization in highways and airport runways. Texas led in the use of lime in soil stabilization.

Magnesium Compounds.—Production of magnesium compounds declined. Production began at the new Freeport plant of E. J. Lavino and Co., Philadelphia, Pa. The plant produced refractory grade periclase for the manufacture of basic refractories. Raw material used at the plant was magnesium hydroxide slurry piped from a neighboring plant of The Dow Chemical Co.

TABLE 17.—Lime sold or used by producers

Year	Quicklime (short tons)	Hydrated lime (short tons)	Total	
			Short tons	Value (thousands)
1952-56 (average)	285,870	210,450	496,320	$4,983
1957	559,426	236,968	796,394	7,489
1958	414,302	276,359	690,661	7,146
1959	414,052	394,725	808,777	8,530
1960	433,405	388,037	821,442	9,087
1961	502,274	377,475	879,749	9,736

Natural Salines.—As a result of expanding Ozark-Mahoning facilities at Brownfield and Monahans, production of natural salines increased 11 percent.

Perlite (Expanded).—Expanded perlite, produced by plants within the State, was used for filter aids, 55 percent; concrete aggregate, 35 percent; building plaster, 5 percent; and other uses, 5 percent.

Salt.—In the past decade, total value of salt produced quadrupled, chiefly because of increased requirements of the rapidly expanding chemical and industrial industries within the State. Approximately 92 percent of salt produced was used by these industries. Salt in brine represented 90 percent of the tonnage sold or used, but accounted for only 65 percent of the total value, reflecting the lower unit value of brine, compared with that of evaporated and rock salt.

TABLE 18.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952-56 (average)	3,179	$9,192	1959	4,519	$17,498
1957	4,612	17,104	1960	4,756	18,222
1958	3,843	15,115	1961	4,695	17,682

Sand and Gravel.—Although production of sand and gravel declined, a 9-percent increase in average unit value permitted total value to remain virtually unchanged from 1960. The increase in price reflected scarcity of gravel supply in some Gulf Coast areas. About 85 percent of the output was furnished by commercial operators at an average price of $1.20 per short ton.

TABLE 19.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1952-56 (average)	19,857	$20,948	4,329	$1,183	24,186	$22,131
1957	19,155	21,979	4,530	1,448	23,685	23,427
1958	27,015	28,703	5,856	2,105	32,871	30,808
1959	29,520	32,098	5,775	2,628	35,295	34,726
1960	26,918	29,857	2,926	897	29,844	30,754
1961	23,272	27,975	4,126	2,716	27,398	30,691

TABLE 20.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,606	$6,166	6,506	$6,478
Paving	3,870	4,335	3,058	2,823
Fill	1,608	676	317	163
Other [1]	552	1,755	404	1,459
Total sand	12,636	12,932	10,285	10,923
Gravel:				
Building	6,981	9,453	7,631	10,478
Paving	6,906	7,189	4,722	6,066
Fill	103	105	126	105
Other [2]	292	178	508	403
Total gravel	14,282	16,925	12,987	17,052
Total sand and gravel	26,918	29,857	23,272	27,975
Government-and-contractor operations:				
Sand:				
Building	----------	----------	52	46
Paving	458	62	720	394
Total sand	458	62	772	440
Gravel:				
Building	----------	----------	373	531
Paving	2,468	835	2,981	1,745
Total gravel	2,468	835	3,354	2,276
Total sand and gravel	2,926	897	4,126	2,716
Grand total	29,844	30,754	27,398	30,691

[1] Includes glass, molding, filtering, and other construction, industrial, and ground sand.
[2] Includes railroad ballast and miscellaneous gravel.

Stone.—The $45.9 million value of stone production during 1961 was second only to the record set in 1959. One-third represented value of shell produced from bays along the Gulf Coast. Approximately one-third of the total output of shell was consumed in manufacturing cement and lime. Other construction uses accounted for the remaining two-thirds.

Sulfur.—A significant development had occurred in the past decade regarding the sulfur market within the State. Sulfur recovered from sour gas replaced Frasch sulfur in many areas, especially in inland markets. In 1952, only 48,000 long tons of sulfur was recovered from gas sources by 8 producers; in 1961, 24 plants recovered 292,000 long tons valued at more than $6 million, an increase of more than 500 percent. In 1961, recovered sulfur accounted for about 10 percent of output.

From 1952 to 1961, the value of Frasch sulfur produced from salt domes on the Texas Gulf Coast declined more than 20 percent, because of increased competition from other sources of domestic Frasch sulfur, foreign Frasch sulfur, and domestic sulfur recovered from sour gas. An important marketing development was the growing trend to deliver sulfur to consumers in liquid form rather than the traditional solid

TABLE 21.—Sand and gravel production in 1961, by counties

(Short tons)

County	Quantity	Value	County	Quantity	Value
Austin	153,608	$85,990	Lavaca	30,652	$12,261
Baylor	28,500	24,600	Lubbock	168,542	397,115
Bexar	2,479,366	2,590,073	McLennan	1,131,253	849,901
Brazoria	87,317	70,819	Mason	8,367	12,024
Brown	30,000	56,240	Matagorda	35,988	27,987
Calhoun	42,718	17,087	Milam	35,700	14,280
Colorado	4,824,623	5,061,440	Mitchell	28,212	41,410
Cooke	133,702	164,409	Montague	28,978	38,554
Cottle	87,000	174,000	Montgomery	45,985	43,157
Dallas	3,167,148	3,696,140	Motley	170,680	403.531
Denton	209,318	83,710	Nolan	85,500	150,000
De Witt	92,373	36,951	Palo Pinto	93,774	74,073
Dickens	28,072	54,429	Parker	46,200	23,100
Donley	4,000	8,000	San Jacinto	88,529	85,525
Erath	456	228	Smith	3,240	7,200
Fayette	607,325	529,130	Stephens	35,000	33,110
Fort Bend	119,864	116,690	Sutton	12,431	19,890
Frio	93,554	37,422	Tarrant	1,626,432	1,642,001
Galveston	96,354	65,980	Throckmorton	29,479	61,903
Gillespie	64,174	57,141	Upshur	11,091	27,991
Gonzales	59,905	46,543	Victoria	750,012	855,144
Grayson	30,000	24,000	Waller	17,083	8,596
Harris	1,031,931	782,287	Webb	46,792	47,149
Hemphill	4,381	1,752	Wharton	17,800	7,120
Jackson	30.461	12,185	Wichita	183,440	177,800
Jefferson	60,300	55,834	Wilbarger	3,130	2,752
Kendall	95,193	38,078	Wilson	93,554	37,422
Kent	2,700	4,250	Wise	15,600	7,800
Kimble	11,998	17,367	Wood	2,194	6,034
Knox	57,000	114,000	Other counties [1]	8,713,673	11,488,160
Lampasas	12,008	24,016			
La Salle	93,554	37,422	Total	27,398,214	30,691,203

[1] Includes Atascosa, Bell, Blanco, Borden, Bowie, Coke, Coleman, Comal, Crosby, El Paso, Guadalupe, Hays, Henderson, Hidalgo, Howard, Hutchinson, Johnson, Jones, Kerr, Liberty, McCulloch, Navarro, Nueces, Oldham, Polk, Potter, Reeves, Robertson, San Patricio, Starr, Taylor, Tom Green, Travis, Uvalde, Ward, and Young Counties, combined to avoid disclosing individual company confidential data.

TABLE 22.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone		Sandstone		Shell		Miscellaneous		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value [1]
1957	19,423	$20,509	1,810	$1,587	9,650	$12,640	(2)	(2)	31,249	$36,154
1958	25,470	24,794	997	851	9,035	12,684	404	$803	36,076	40,912
1959	29,141	30,064	2,406	1,189	10,310	14,419	177	257	42,172	47,787
1960	26,620	26,208	1,816	1,036	10,304	15,798	159	212	39,029	45,088
1961	24,439	25,718	2,266	1,511	10,531	15,373	905	695	38,316	45,874

[1] Includes other stone and stone indicated by footnote 2.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Total."

form. Since sulfur is used in liquid form by the consumers, shipments in this way reduced handling costs, increased efficiency, and improved inventory management. In 1961, approximately one-fourth of all domestic Frasch shipments were made in molten form.

New construction and expansion of existing sulfur recovery facilities continued. Two new producers reported production during the year. Gillring Oil Co. recovered sulfur from its Fashing plant in Atascosa County; The Atlantic Refining Co. reported production of sulfur from its new facility at its Port Arthur refinery in Jefferson County.

Trans-Jeff Chemical Corp. expanded sulfur capacity at its plant in McMullen County from 18½ tons to 100 tons a day; plans were announced for a further increase to 170 tons a day in 1962. Shell Oil Co. was constructing two sulfur recovery facilities; at its Bryans Mill plant in Cass County, unit capable of recovering 170 tons daily was being built; at its Karnes County Person plant a new recovery unit was to have a capacity of 11 tons a day.

TABLE 23.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1952–56 (average)	3,691	3,597	$93,091
1957	3,366	2,880	70,225
1958	2,588	2,616	61,621
1959	2,519	2,970	$68,998
1960	2,679	2,747	62,855
1961	2,778	2,730	62,720

Talc and Soapstone.—Increasing activity characterized developments in talc mining of west Texas. Eight producers in Gillespie and Hudspeth Counties reported an output of 78,000 tons, a 17-percent increase over that of 1960. However, the average unit value declined 4 percent. The talc was used for ceramics, 69 percent; carrier for insecticides and fungicides, 7 percent; and other uses, 24 percent.

Sierra Talc Co. acquired the assets of another company and opened its own operation near Van Horn in Hudspeth County during the year.

Vermiculite (Exfoliated).—Crude vermiculite, obtained from other States, was exfoliated at four plants in Burnet, Dallas, and Harris Counties.

Water.—The U.S. Study Commission-Texas completed a 3-year study and issued a report to the President on inventory of water and land resources for optimum development to meet projected water requirements for the next 50 years. The Commission included State representatives as well as representatives from eight of Texas major river basin authorities—the Brazos, Colorado, Guadalupe, Neches, Nueces, San Antonio, San Jacinto, and Trinity. The first construction phase recommended constructing 30 major water reservoirs by 1975 for municipal and industrial water supply and flood control. The final phase recommended constructing 116 additional major water reservoirs by 2010 for water supply, flood control, hydroelectric power, and ground-water recharge uses.

The sea water conversion plant at Freeport was damaged in September by Hurricane Carla, but the plant was reactivated 2 weeks after the storm.

The Texas Board of Water Engineers approved the Sabine River Authority request to build the $60 million multipurpose Toledo Bend Dam and Reservoir. The project, on the Sabine River near Weirgate, would provide water, hydroelectric power, improved river navigation, and recreation benefits in both Texas and Louisiana. The reservoir was to have a storage capacity estimated at 4.8 million acre-feet and was to cover parts of Panola, Sabine, and Shelby Counties. The project was to be financed jointly by Texas and Louisiana, each providing $15 million. The remainder would be raised by revenue bonds to be retired by sale of electricity generated at the dam.

The U.S. Army Corps of Engineers began preliminary dredging of a channel from the Gulf of Mexico into Matagorda Bay; later, the channel was to be deepened and an enlarged turning basin added.

METALS

Smelting, reduction, and refining operations were dependent upon out-of-State and foreign markets for a large part of their sales and, thus, were affected by national economic trends more than by local or Statewide trends. Most metal demand was slow during the first quarter—a carryover from the mild recession of 1960. During the remainder of the year a modest but steady recovery was reported.

Aluminum.—Aluminum metal production, from three plants, was less than in 1960 because of lower operating rates during the first half of the year and hurricane damage during September. Aluminum-chemical and cryolite recovery units were added to the Point Comfort plant of Aluminum Company of America (Alcoa).

Consolidated General Products, Inc., completed a $3 to $5 million aluminum casting and rolling mill in Houston. The new plant was the first in the Southwest to produce aluminum sheet from ingot. Consolidated also had facilities for roll-coating with baked enamel about 2 million pounds of aluminum a month in strips up to 18 inches wide. The new plant had a gas-fired reverberatory furnace that held 40,000 pounds of aluminum alloy.

Reynolds Metals Co., developer and manufacturer of aluminum drill pipe, reported successful testing of the first string of pipe to undergo commercial tests. Reed Roller Bit Co. developed and manufactured the tool joints. Shell Oil Co. began using the aluminum drill pipe in south Texas.

Antimony.—Antimony was recovered from Mexican and Bolivian ores at the Laredo smelter of Texas Mining & Smelting Division of National Lead Co. Much of the ore was bartered for surplus U.S. grain by the Commodity Credit Corp. The resultant metal was added to the supplemental stockpile.

Cadmium.—Cadmium was recovered from flue dusts resulting from zinc smelting. The metal was recovered at a unit of the electrolytic zinc smelter of American Smelting & Refining Co. at Corpus Christi.

Copper.—Copper smelting and refining operations increased in the last half of the year as demand improved and metal stocks were substantially reduced.

Gold.—Gold was recovered in smelting lead and copper ores and concentrates and residues from zinc smelters at the El Paso lead smelter of American Smelting & Refining Co. None of the gold was credited to Texas sources.

Iron Ores.—Iron ore was produced from open pits in Cass, Cherokee, and Morris Counties by two integrated steel companies and one independent producer. Iron ore imported from Mexico and South America supplemented the local ore as blast furnace feed. Units to improve recovery of iron in ore and increase mill output were added to the mill of Lone Star Steel Co. The company also completed a $7 million expansion to its Daingerfield steelmill with a sheetmill and additional extrusion facilities for producing small-diameter black and galvanized pipe and 16- to 18-inch-diameter spiral weld pipe. Two idle open hearth furnaces were reactivated late in January; another was reactivated in May. Sheffield Division of Armco Steel Corp. added a new plate heat-treating line to process wide plates of high strength alloy steel, and a deepwater dock and material-unloading equipment on the Houston ship channel. A $1 million vacuum ladle degasser with auxiliary equipment was built at the Houston works of Cameron Iron Works. A unique mobile pipemill, which produced 8-inch pipe from steel coils and laid it along the pipeline right-of-way at a rate of 50 feet a minute, was being used on a 30-mile section of the Cherokee Pipe Line Co. product line between Wichita Falls, Tex., and Oklahoma City, Okla.

Steel companies and steel pipe manufacturers welcomed two large pipeline authorizations of the Federal Power Commission, the 1,100-mile, almost parallel lines of Dixie Pipeline Co. and Trans-Continental Gas Pipeline Corp. from the Houston area to North Carolina. Each system was to cost $40 to $60 million.

Lead.—Smelter operations in Texas were at a slightly lower rate than in 1960.

Magnesium.—Improved magnesium metal sales and depleted company metal stocks resulted in capacity operations of The Dow Chemical Co. plant A and in reactivating two of eight units of plant B at yearend.

Manganese.—Imported manganese ores were processed at the Houston plant of Tenn-Tex Alloy & Chemical Corp. for use as an alloying agent in steel. The plant was shut down at the close of 1960 but reopened early in the first quarter of 1961.

Silver.—Silver was recovered in smelting lead and copper ores and concentrates and residues from zinc smelters at the El Paso lead smelter of American Smelting & Refining Co. None of the silver was credited to Texas sources.

Tin.—The Texas City tin smelter of Wah Chang Corp. produced tin from ores imported from Bolivia and the Far East.

Tungsten.—Tungsten was recovered from domestic and imported ores at the Texas City tin smelter of Wah Chang Corp.

Uranium.—Though uranium mine production stopped in 1961, stockpiled ores were processed at the Falls City mill of Susquehanna-Western, Inc. Exploration for new deposits continued at a reduced level.

Zinc.—Curtailed production by zinc smelters helped the domestic industry to decrease the supply-demand imbalance, reduce metal stocks, and firm metal prices. The electrolytic zinc smelter of American Smelting & Refining Co. at Corpus Christi reduced output 11 percent in March; curtailed operations were maintained at its retort smelter in Amarillo. The Dumas retort smelter of American Zinc Co. of Illinois also operated at a reduced rate.

REVIEW BY COUNTIES

Minerals were produced in 238 of the 254 counties. The 10 leading counties, in order of mineral production value, were Andrews, Ector, Brazoria, Crane, Winkler, Scurry, Harris, Gaines, Rusk, and Gregg. Crude oil was reported from 199 counties, natural gas from 184 and, natural gas liquid from 108. Nonmetals were produced in 162 counties and metals were mined in 6 counties.

It was impossible to assign county origin to parts of some commodities reported in table 1; for example, crushed stone and sand and gravel produced by portable plants and gem stones found by numerous hobbyists and collectors. This review is limited to counties having significant production or industry information.

Anderson.—Total mineral value increased only 1 percent, compared with 1960; modest increases in crude oil and natural gas production were offset by a decrease in natural gas liquid production. Part of the increase was due to expanded production in Fairway field, where three new pays were developed. Anderson County led east Texas in overall drilling activity with 154 exploratory wells; 105 were productive. Pure Oil Co. was building a 6-million-cubic-foot-per-day gasoline plant in the Bakke field. Other processing plants included Cayuga plant of Tidewater Oil Co.; Bethel plant of Texaco, Inc.; and Slocum plant of Slocum Gas Co. Crude oil was refined at Tucker refinery of Anderson Refining Corp.

TABLE 24.—Value of mineral production in Texas, by counties[1]

County	1960[2]	1961	Minerals produced in 1961 in order of value
Anderson	$21,785,600	$22,095,900	Petroleum, natural gas, natural gas liquids.
Andrews	219,707,400	222,681,100	Petroleum, natural gas liquids, natural gas.
Angelina	637,305	1,121,855	Clays, lime, stone, natural gas, petroleum.
Aransas	10,267,900	10,077,200	Petroleum, natural gas, natural gas liquids, shell.
Archer	27,603,896	27,888,700	Petroleum, natural gas liquids, natural gas, stone.
Atascosa	15,606,886	15,222,663	Petroleum, natural gas, natural gas liquids, sand and gravel.
Austin	5,734,276	6,192,560	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Bastrop	734,833	834,536	Clays, petroleum, natural gas.
Baylor	8,258,100	8,400,500	Petroleum, sand and gravel, natural gas.
Bee	9,315,465	10,790,800	Natural gas, petroleum, natural gas liquids, stone.
Bell	355,528	394,872	Stone, sand and gravel.
Bexar	16,715,901	18,426,955	Cement, stone, sand and gravel, petroleum, clays.
Blanco	148,901	(3)	Sand and gravel.
Borden	32,030,900	29,912,872	Petroleum, natural gas, sand and gravel.
Bosque	-----------	31,807	Stone.
Bowie	(3)	(3)	Sand and gravel, natural gas, petroleum.
Brazoria	147,928,311	147,332,159	Petroleum, natural gas, natural gas liquids, bromine, magnesium chloride, salt, lime, magnesium compounds, sulfur, sand and gravel, stone.
Brazos	289,700	91,900	Natural gas.
Brewster	15,285	8,700	Clays, gem stones.
Briscoe	(3)	(3)	Clays.
Brooks	13,627,800	14,036,600	Petroleum, natural gas, natural gas liquids.
Brown	1,659,771	1,790,627	Petroleum, stone, natural gas, sand and gravel, clays.
Burleson	4,300	19,250	Stone, petroleum.
Burnet	2,106,467	3,780,506	Stone, graphite.
Caldwell	7,820,100	7,931,600	Petroleum.
Calhoun	16,362,966	16,626,374	Natural gas, petroleum, shell, lime, natural gas liquids, sand and gravel.
Callahan	6,571,600	6,666,000	Petroleum, natural gas.
Cameron	201,100	205,900	Natural gas, petroleum.
Camp	1,101,600	1,117,300	Petroleum, natural gas.
Carson	29,101,510	29,305,900	Petroleum, natural gas, natural gas liquids.
Cass	7,489,125	7,273,155	Petroleum, natural gas, iron ore, natural gas liquids.
Chambers	56,374,712	56,546,869	Petroleum, natural gas, shell, salt, natural gas liquids.
Cherokee	4,496,360	4,960,400	Petroleum, iron ore, natural gas liquids, natural gas, clays.

See footnotes at end of table.

TABLE 24.—Value of mineral production in Texas, by counties[1]—Continued

County	1960[2]	1961	Minerals produced in 1961 in order of value
Childress	------------	$132,300	Petroleum.
Clay	$13,343,000	13,580,890	Petroleum, natural gas liquids, natural gas, stone.
Cochran	28,283,300	26,576,000	Petroleum, natural gas, natural gas liquids.
Coke	30,477,807	30,004,629	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	11,554,888	11,882,198	Petroleum, natural gas, sand and gravel, natural gas liquids, clays.
Collin	77,500	42,900	Stone.
Collingsworth	994,800	995,700	Natural gas, petroleum.
Colorado	20,166,334	21,740,040	Natural gas, natural gas liquids, sand and gravel, petroleum.
Comal	3,363,010	(3)	Stone, lime, sand and gravel.
Comanche	234,300	270,070	Petroleum, natural gas, stone, clays.
Concho	393,300	399,300	Petroleum, natural gas.
Cooke	29,948,166	30,336,953	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Coryell	78,485	96,918	Stone.
Cottle	214,700	431,800	Stone, sand and gravel, petroleum.
Crane	121,791,300	123,687,900	Petroleum, natural gas liquids, natural gas.
Crockett	23,483,200	24,626,300	Petroleum, natural gas, natural gas liquids, gem stones.
Crosby	1,352,180	1,396,394	Sand and gravel, petroleum.
Culberson	3,585,800	3,650,150	Petroleum, natural gas, barite.
Dallam	909,200	931,800	Natural gas.
Dallas	18,637,491	16,109,586	Cement, sand and gravel, stone, clays.
Dawson	16,324,900	16,399,540	Petroleum, natural gas liquids, stone, natural gas.
Deaf Smith	103,210	------------	
Denton	514,094	550,054	Petroleum, natural gas, clays, sand and gravel, stone.
De Witt	7,966,173	8,159,760	Petroleum natural gas, sand and gravel, stone.
Dickens	221,956	325,629	Stone, petroleum, sand and gravel, natural gas.
Dimmit	1,282,600	1,301,100	Petroleum, natural gas.
Donley	124,900	210,300	Stone, natural gas, sand and gravel.
Duval	36,343,013	37,290,697	Petroleum, natural gas, natural gas liquids, salt.
Eastland	4,830,489	5,261,088	Natural gas liquids, petroleum, natural gas, clays.
Ector	216,500,712	218,305,028	Petroleum, natural gas liquids, natural gas, cement, stone, clays.
Edwards	4,738	9,790	Stone, petroleum.
Ellis	844,640	(3)	Cement, stone, clays.
El Paso	5,086,928	5,179,936	Cement, stone, sand and gravel.
Erath	996,538	1,822,528	Natural gas, natural gas liquids, petroleum, sand and gravel.
Falls	38,400	69,500	Petroleum, stone.
Fannin	123,468	------------	
Fayette	1,161,975	1,300,857	Petroleum, sand and gravel, clays, stone, natural gas.
Fisher	13,496,424	14,085,802	Petroleum, gypsum, natural gas liquids, natural gas, clays.
Floyd	5,200	5,300	Petroleum.
Foard	2,890,400	2,769,500	Petroleum, natural gas.
Fort Bend	34,486,724	35,208,548	Petroleum, sulfur, natural gas, salt, sand and gravel, clays, natural gas liquids, stone.
Franklin	14,843,900	13,890,900	Petroleum, natural gas liquids, natural gas.
Freestone	2,749,008	2,794,519	Petroleum, natural gas, clays, stone.
Frio	4,796,242	4,875,122	Petroleum, natural gas, natural gas liquids, sand and gravel.
Gaines	87,696,900	88,766,150	Petroleum, natural gas liquids, natural gas, stone.
Galveston	36,933,657	37,859,325	Petroleum, natural gas, shell, sulfur, natural gas liquids, sand and gravel, clays.
Garza	17,717,048	17,901,000	Petroleum, natural gas.
Gillespie	116,655	77,085	Sand and gravel, stone, talc.
Glasscock	4,805,500	4,788,500	Petroleum, natural gas.
Goliad	9,278,400	8,775,700	Natural gas, petroleum.
Gonzales	277,477	277,419	Petroleum, clays, sand and gravel, stone, natural gas.
Gray	58,896,800	60,043,600	Petroleum, natural gas liquids, natural gas.
Grayson	20,165,200	20,862,178	Petroleum, stone, natural gas, natural gas liquids, sand and gravel.
Gregg	72,462,000	72,503,500	Petroleum, natural gas liquids, natural gas.
Grimes	35,900	49,280	Natural gas, stone, petroleum, gem stones.
Guadalupe	13,112,761	13,288,162	Petroleum, sand and gravel, stone, clays, natural gas.
Hale	3,976,800	4,033,700	Petroleum, natural gas.
Hall	170,000	132,000	Stone.
Hamilton	152,300	99,970	Natural gas, stone.
Hansford	36,502,000	36,720,500	Natural gas, petroleum, natural gas liquids.
Hardeman	2,639,667	2,579,497	Petroleum, gypsum, stone.
Hardin	24,269,100	24,501,277	Petroleum, natural gas, natural gas liquids, lime.
Harris	88,620,932	104,684,791	Petroleum, cement, natural gas liquids, natural gas, salt, lime, sand and gravel, stone, clays.
Harrison	23,299,177	22,018,101	Petroleum, natural gas, natural gas liquids, coal, clays.
Hartley	1,918,500	1,964,700	Natural gas, petroleum.
Haskell	12,717,550	12,835,600	Petroleum, natural gas.
Hays	(3)	(3)	Sand and gravel, stone.
Hemphill	731,410	642,552	Natural gas, petroleum, sand and gravel.

See footnotes at end of table.

TABLE 24.—Value of mineral production in Texas, by counties[1]—Continued

County	1960 [2]	1961	Minerals produced in 1961 in order of value
Henderson	$5,061,276	$4,905,183	Natural gas, petroleum, natural gas liquids, sand and gravel, clays.
Hidalgo	25,649,106	26,356,160	Natural gas, natural gas liquids, petroleum, sand and gravel, clays.
Hill	50,384	205,915	Stone, petroleum.
Hockley	25,274,200	29,792,000	Petroleum, natural gas liquids, natural gas.
Hood		17,046	Stone.
Hopkins	5,731,453	5,548,128	Petroleum, natural gas, natural gas liquids, clays.
Houston	1,814,700	1,877,103	Petroleum, natural gas, stone.
Howard	40,049,079	42,442,433	Petroleum, natural gas liquids, sand and gravel, natural gas.
Hudspeth	527,793	475,863	Talc, stone, gypsum.
Hunt	19,900	20,200	Petroleum.
Hutchinson	63,905,445	61,913,167	Petroleum, natural gas, natural gas liquids, sand and gravel, salt.
Irion	2,388,500	2,489,900	Petroleum, natural gas liquids, natural gas.
Jack	16,437,400	16,600,118	Petroleum, natural gas, stone, natural gas liquids.
Jackson	41,329,614	42,075,185	Petroleum, natural gas, natural gas liquids, sand and gravel.
Jasper	2,168,900	2,207,700	Petroleum, natural gas, natural gas liquids.
Jefferson	61,729,615	65,790,636	Petroleum, sulfur, natural gas, natural gas liquids, salt, sand and gravel, clays.
Jim Hogg	14,405,400	14,716,200	Petroleum, natural gas, natural gas liquids.
Jim Wells	49,626,300	49,306,500	Petroleum, natural gas liquids, natural gas.
Johnson	1,083,124	1,281,176	Lime, stone, sand and gravel.
Jones	18,042,723	17,491,654	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Karnes	15,970,800	14,767,126	Petroleum, natural gas, natural gas liquids, uranium.
Kaufman	2,142,898	1,925,826	Petroleum, stone, natural gas.
Kendall	68,710	38,078	Sand and gravel.
Kenedy	3,536,500	3,441,100	Natural gas, petrleum, natural gas liquids.
Kent	25,929,000	26,303,150	Petroleum, natural gas, sand and gravel.
Kerr	63,115	(3)	Sand and gravel.
Kimble	38,447	26,367	Sand and gravel, natural gas, petroleum.
King	3,157,900	3,203,200	Petroleum, natural gas.
Kinney	6,014		
Kleberg	41,728,571	40,035,200	Petroleum, natural gas liquids, natural gas, salt, stone.
Knox	7,665,500	7,973,900	Petroleum, sand and gravel, stone, natural gas.
Lamb	2,727,400	3,066,400	Petroleum, stone, natural gas.
Lampasas	20,828	24,016	Sand and gravel.
La Salle	1,357,400	1,419,122	Petroleum, natural gas, sand and gravel.
Lavaca	10,238,602	12,306,581	Natural gas liquids, natural gas, petroleum, stone, sand and gravel.
Lee	92,080	91,500	Petroleum, natural gas.
Leon	3,026,600	3,127,687	Natural gas, petroleum, stone.
Liberty	43,540,110	44,906,579	Petroleum, sulfur, natural gas, sand and gravel, natural gas liquids.
Limestone	1,518,505	1,686,947	Petroleum, natural gas, stone, clays.
Lipscomb	2,113,600	2,154,200	Petroleum, natural gas.
Live Oak	16,201,100	16,514,996	Natural gas, petroleum, natural gas liquids, uranium, gem stones.
Llano	921,912	144,547	Stone, feldspar.
Loving	10,442,400	10,594,000	Petroleum, natural gas.
Lubbock	1,403,311	1,597,115	Petroleum, sand and gravel, natural gas.
Lynn	1,474,200	1,495,300	Petroleum, natural gas.
Madison	1,232,700	1,286,512	Natural gas, petroleum, natural gas liquids, stone.
Marion	5,862,000	5,917,800	Petroleum, natural gas, natural gas liquids.
Martin	6,132,100	6,219,600	Petroleum, natural gas.
Mason	6,501	12,024	Sand and gravel.
Matagorda	39,914,888	43,118,336	Petroleum, natural gas, stone, natural gas liquids, sand and gravel, clays.
Maverick	3,016,100	3,059,200	Petroleum, natural gas.
McCulloch	(3)	(3)	Sand and gravel, petroleum.
McLennan	4,159,051	4,441,070	Cement, sand and gravel, stone, clays, petroleum.
McMullen	8,241,442	8,814,500	Natural gas, petroleum, natural gas liquids.
Medina	956,361	938,960	Petroleum, clays, natural gas.
Menard	322,800	327,400	Petroleum, natural gas.
Midland	53,613,550	57,008,000	Petroleum, natural gas, natural gas liquids.
Milam	(3)	(3)	Coal, petroleum, sand and gravel.
Mitchell	7,189,239	7,287,010	Petroleum, natural gas, sand and gravel.
Montague	18,486,804	18,537,434	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Montgomery	28,399,481	28,218,221	Do.
Moore	44,977,422	44,350,879	Natural gas, natural gas liquids, helium, petroleum.
Morris	(3)	(3)	Iron ore.
Motley	1,371,422	1,520,831	Petroleum, sand and gravel.
Nacogdoches	2,644,829	2,705,475	Natural gas, clays, natural gas liquids, petroleum.
Navarro	6,528,814	6,504,764	Petroleum, sand and gravel, stone, natural gas, clays.
Newton	5,122,900	5,205,000	Petroleum, natural gas.

See footnotes at end of table.

TABLE 24.—Value of mineral production in Texas, by counties [1]—Continued

County	1960 [2]	1961	Minerals produced in 1961 in order of value
Nolan	$27,209,276	$26,083,517	Petroleum, cement, gypsum, natural gas liquids, natural gas, stone, sand and gravel.
Nueces	67,681,722	66,541,618	Petroleum, natural gas, natural gas liquids, cement, lime, stone, sand and gravel, clays.
Ochiltree	23,487,700	23,594,600	Petroleum, natural gas, natural gas liquids.
Oldham	489,622	624,788	Sand and gravel, natural gas, petroleum.
Orange	12,154,977	12,563,585	Petroleum, natural gas, cement, natural gas liquids, clays.
Palo Pinto	2,657,112	3,087,453	Natural gas, petroleum, natural gas liquids, clays, sand and gravel.
Panola	49,101,400	45,792,700	Natural gas, natural gas liquids, petroleum.
Parker	2,600,639	2,474,972	Natural gas liquids, natural gas, stone, clays, petroleum, sand and gravel.
Pecos	59,376,900	60,125,262	Petroleum, natural gas, natural gas liquids, stone.
Polk	4,889,260	5,060,867	Petroleum, natural gas, stone, sand and gravel, natural gas liquids.
Potter	19,049,159	20,110,940	Natural gas, helium, sand and gravel, natural gas liquids.
Randall	103,210	------------	
Reagan	26,213,300	26,526,200	Petroleum, natural gas liquids, natural gas.
Red River	113,000	114,600	Petroleum.
Reeves	9,978,173	7.793,556	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Refugio	61,569,600	62,836,400	Petroleum, natural gas, natural gas liquids.
Roberts	11,477,000	11,723,000	Natural gas, petroleum.
Robertson	388,591	417,293	Sand and gravel, petroleum, stone, natural gas, gem stones.
Rockwall	------------	42,800	Stone.
Runnels	16,301,545	16,218,400	Petroleum, natural gas, natural gas liquids.
Rusk	72,526,060	73,080,000	Petroleum, natural gas liquids, natural gas, clays.
San Augustine	25,978	------------	
San Jacinto	1,673,425	1,702,025	Petroleum, natural gas, sand and gravel.
San Patricio	46,314,037	46,638,014	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays.
Schleicher	11.148,200	11,309,200	Petroleum, natural gas, natural gas liquids.
Scurry	106,304,125	106,577,600	Petroleum, natural gas liquids, natural gas, clays.
Shackelford	10,951,419	11,087,100	Petroleum, natural gas, natural gas liquids, stone.
Shelby	1,079,400	1,105,800	Natural gas, petroleum.
Sherman	25,941,500	26,585,000	Natural gas, petroleum.
Smith	19,740,298	19,743,070	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Starr	25,445,743	26,120,914	Petroleum, natural gas, natural gas liquids, sand and gravel, pumicite, clays.
Stephens	9,702,938	10,034,110	Petroleum, natural gas liquids, natural gas, sand and gravel.
Sterling	2,417,400	2,457,400	Petroleum, natural gas.
Stonewall	20,042.953	19,920,700	Petroleum, natural gas liquids, natural gas.
Sutton	647,900	683,690	Natural gas, sand and gravel, petroleum.
Tarrant	9,768,900	7,531,457	Cement, sand and gravel, stone, clays.
Taylor	15,261,580	15,601,262	Petroleum, natural gas, stone, sand and gravel, clays.
Terrell	3,084,000	3.162,420	Natural gas, stone.
Terry	20,395,800	18,612,531	Petroleum, sodium sulfate, natural gas liquids, natural gas.
Throckmorton	8,586,300	8,771,203	Petroleum, sand and gravel, natural gas.
Titus	13,653,700	13,848,300	Petroleum, natural gas.
Tom Green	6,505,435	6,856,884	Petroleum, stone, natural gas, natural gas liquids, sand and gravel.
Travis	3,507,513	3,693,001	Stone, lime, sand and gravel, petroleum.
Trinity	10,567	20,649	Stone.
Tyler	2,374,900	2,413,300	Petroleum, natural gas.
Upshur	17,499,888	17,628,691	Petroleum, sand and gravel.
Upton	52,961,900	49,676,500	Petroleum, natural gas liquids, natural gas.
Uvalde	(3)	(3)	Asphalt, sand and gravel, basalt.
Val Verde	631,000	646,600	Natural gas, petroleum.
Van Zandt	20,325,118	20,138,390	Petroleum, salt, natural gas liquids, natural gas.
Victoria	21,598,570	22,511,744	Petroleum, natural gas, sand and gravel, natural gas liquids.
Walker	123,116	352,796	Stone,clays, petroleum.
Waller	38,968,077	39,983,210	Natural gas, natural gas liquids, petroleum, stone, sand and gravel.
Ward	66,004,349	66,845,116	Petroleum, natural gas, natural gas liquids, sodium sulfate, sand and gravel, salt, stone, gypsum.
Washington	572,900	600,675	Petroleum, stone, natural gas.
Webb	6,614,140	6,744,749	Petroleum, natural gas, sand and gravel.
Wharton	46,432,635	48,545,497	Sulfur, petroleum, natural gas, natural gas liquids, sand and gravel.
Wheeler	7,270,400	7,569,000	Petroleum, natural gas liquids, natural gas, stone.
Wichita	35,237,458	35,541.660	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.

See footnotes at end of table.

TABLE 24.—Value of mineral production in Texas, by counties [1]—Continued

County	1960 [2]	1961	Minerals produced in 1961 in order of value
Wilbarger	$18,578,695	$18,804,952	Petroleum, natural gas, sand and gravel.
Willacy	6,419,100	6,526,500	Petroleum, natural gas.
Williamson	2,687,655	2,230,663	Stone, lime, petroleum.
Wilson	1,388,396	1,417,968	Petroleum, clays, sand and gravel, natural gas.
Winkler	111,707,000	114,260,100	Petroleum, natural gas, natural gas liquids.
Wise	27,793,433	28,104,882	Petroleum, natural gas, natural gas liquids, stone, clays, sand and gravel.
Wood	48,646,575	49,114,334	Petroleum, natural gas, natural gas liquids, sand and gravel.
Yoakum	48,460,817	48,792,947	Petroleum, natural gas liquids, natural gas, salt.
Young	17,982,800	18,145,902	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Zapata	3,207,500	3,261,700	Petroleum, natural gas, natural gas liquids.
Zavala	838,800	853,800	Petroleum, natural gas.
Undistributed	18,727,877	75,616,750	
Total	4,116,664,000	4,224,909,000	

[1] The following counties are not listed because no production was reported: Armstrong, Bailey, Bandera, Castro, Delta, Jeff Davis, Lamar, Mills, Presidio, Rains, Real, Sabine, San Saba, Somervell, and Swisher.

[2] Revised figures.

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Andrews.—Andrews County led in total mineral value and in crude oil production. Improved mineral activity, principally in crude oil and natural gas, resulted in a 1-percent increase in total mineral value, compared with 1960. Six gasoline plants recovered natural gas liquids valued at nearly $20 million. Sulfur was recovered from sour natural gas at Andrews plant of Parker-Andrews Co. and Midland Farms plant of Pan American Petroleum Corp. Large crude oil reserves were discovered in Inez field in Ellenburger strata. Later, the Fusselman pay was opened to add substantially to the oil reserve; the area previously produced from shallow formations only.

Angelina.—The value of mineral output increased 76 percent over 1960 partly because of expanded coverage of the lime producers. Bentonite was mined from open pits near Zavalla by Magnet Cove Barium Corp. and Bennett-Clark Co., Inc.

Aransas.—Declines in natural gas liquids and shell outputs were responsible for the 2-percent drop in total value—gains in crude oil and natural gas production compensated for part of the loss. A 15-million-cubic-foot-per-day natural gasoline plant was being built at Fulton Beach by Sun Oil Co. Pearce gasoline plant of Tenneco Oil Co. extracted gas liquids. Carbon black was recovered at the Kosmos A plant of United Carbon Co., Inc. Shell was dredged from shallow bays bordering the county. Exploration drilling resulted in discovery of a new gasfield in the Frio formation at South Copano Bay field.

Archer.—There was a 1-percent rise in mineral value, compared with 1960, as combined gains of crude oil and natural gas offset loss of natural gas liquids. Expanded exploration discovered five new important oilfields in Mississippian strata. Various producers quarried and prepared sandstone for concrete aggregate and roadstone for District 3 of Texas Highway Department.

Atascosa.—Value of mineral production was 2 percent less than in 1960 because of curtailed crude oil and sand and gravel output. Natural gas liquide were recovered at Jourdantown plant of Humble

Oil & Refining Co., Fashing plant of Warren Petroleum Corp., and Pleasanton cycle plant of Lone Star Producing Co. Sulfur was recovered from sour gas at the Fashing plant of National Sulphur Co. at Karnes City. Glass sand and other industrial sands were recovered from open pits south of San Antonio by Espey Silica Sand Co. and West-Land Silica Sand Co.

Austin.—Mineral production increased 8 percent in value, compared with 1960; small value increases occurred in crude oil, natural gas, and natural gas liquids. A 15-million-cubic-foot-per-day gas processing plant to recover an estimataed 21,000 gallons of liquids including 6,200 gallons of propane, 4,500 gallons of butane, 4,200 gallons of debutanized gasoline, and 6,100 gallons of condensate was built as a joint venture of Shell Oil Co., Arkansas Fuel Oil Corp., and others. Located 4 miles west of Sealy, the plant treated gas from the Sealy field.

Bastrop.—Fire clay mined from open pits near Elgin by Elgin-Butler Brick Co., Elgin Standard Brick Manufacturing Co., and Payne Brick Co. was primarily responsible for the 14-percent increase in total mineral value over 1960. Elgin Standard Brick Manufacturing Co. added a tunnel kiln and related facilities to its Elgin plant to increase capacity for making glazed bricks and tile.

Baylor.—A 2-percent rise in total mineral value resulted from small increases in crude oil and sand and gravel production. Contractors furnished paving sand and gravel for District 3 of Texas Highway Department.

Bee.—Total mineral value increased 16 percent over 1960 because of increased production of crude oil, natural gas, and natural gas liquids. Natural gas liquids were recovered at three cycle plants. A new 32-million-cubic-foot-per-day gas processing plant, designed for daily extraction of about 86,000 gallons of mixed liquids, was under construction by Tidewater Oil Co. Gas from 26 wells in the Normanna field was to supply the plant. Crude oil was processed at Pettus refinery of Danaho Refining Co. A new prolific and possibly major gasfield was discovered in the Edwards formation of Pawnee field through deeper exploration of the Edwards trend. The new production was found below 13,000 feet and was nearly 8,000 feet below prior field completions.

Bexar.—The nonmetallic mineral industry, together with crude oil, increased total value of production 10 percent over that of 1960. Producers of clay, stone, and sand and gravel were responsible for most of the increase. Limestone was quarried from stone deposits near San Antonio by Longhorn Portland Cement Co. and San Antonio Cement Co. for use in manufacturing cement. Other crushed stone producers included Colglazier Construction Co., McDonough Brothers, Inc., and Acme Crushed Stone Co. Principal stone uses were as concrete aggregate, roadstone, riprap, and railroad ballast. Fire clay was mined from open pits near Elmendorf by Alamo Clay Products Co. for manufacturing building and face brick. Miscellaneous clay was mined from pits in San Antonio by Barrett Industries and by Featherlite Co. of San Antonio for use in manufacturing lightweight aggregate. Building and paving sand and gravel were prepared from open pits by 11 producers; District 15 of Texas Highway Department prepared paving gravel.

Bowie.—Minerals including petroleum, natural gas, and sand and gravel were 9 percent greater in value than in 1960. Structural and paving sand and gravel were produced at a fixed plant of Gifford-Hill Co., Inc.

Brazoria.—The county ranked first in natural gas production and third in total mineral value. Mineral value approximated that of 1960. Chemical and petrochemical installations used crude materials—crude oil, natural gas, natural gas liquids, salt, lime, sulfur, and shell—from the county and surrounding area to produce ethylene, propylene, and butylene. These three materials were further processed into organic intermediates and coproducts for use in manufacturing plastics, resins, synthetics, paints, and detergents. Natural gas liquids were recovered at three gas processing plants; one was Bayou plant of Phillips Petroleum Co., third largest plant in the State. Crude oil was processed at Sweeny refinery of Phillips Petroleum Co. Carbon black was produced at Sweeny No. 204 channel plant of Columbian Carbon Co. Paving sand and gravel was prepared for District 12 of Texas Highway Department.

A 1,500-barrel-per-day benzene unit was added to Sweeny refinery of Phillips Petroleum Co.; benzene was piped to the Gulf Coast for transshipments by barge up inland waterways to chemical manufacturers in the middle and north-central United States. Ethylene capacity of the Sweeny plant was increased from 250 million to 550 million tons a year.

Plant A (Freeport) of The Dow Chemical Co. operated at near capacity throughout 1961 to recover magnesium from sea water; two of eight units at the company B plant at Velasco were reactivated as demand improved and metal inventories declined. Propylene carbonate used in natural gas purification as a specialty solvent, and as a chemical intermediate was produced in commercial quantities for the first time. The company also produced salt in brine for use in manufacturing sodium and chlorine chemicals and lime from oystershell for use in producing magnesium. Dow made a wide variety of organic and inorganic chemicals at its vast Freeport complex, including ethylene, propylene, butadiene, ethylene oxide, triethylene glycol, glycerine, soda ash, acetylene, styrene, and acrylonitrile. A 51-mile LP gas pipeline from Sheridan to Markham was built by the Brazos Oil & Gas Division of Dow and connected with an existing Brazos system for transmission to chemical plants at Freeport. Ethyl-Dow Chemical Co., a subsidiary, continued production of ethylene dibromide from sea water; the product was used as an additive in antiknock gasoline fluids. Another subsidiary, Dow-Badische Chemical Corp., added a 40-million-pound-per-year caprolactan unit to its Freeport plant.

A large petrochemical plant to cost between $80 and $100 million was being built on Chocolate Bayou (near Alvin) by Monsanto Chemical Co. The new units included a 500-million-pound-per-year ethylene facility, a 42-million-pound-per-year benezene unit, a 50-million-pound-per-year naphthalene unit, and a 50-million-pound-per-year-phenol unit. Facilities for producing propylene, cumene, acetone, and ethylbenzene were included in the complex.

Nalco Chemical Co. was constructing a $10 million plan at Freeport to convert 26 million pounds of lead a year to lead alkyls for producing 40 million pounds of tetraethyl lead or 34 million pounds of tetramethyl lead for use as a gasoline additive.

Brooks.—Slight production gains of mineral fuels resulted in a 3-percent increase in value over 1960. Carbon black was recovered at the Dixie plant of United Carbon Co., Inc. Natural gas liquids were extracted at Kelsey cycling plant of Humble Oil & Refining Co. Accelerated exploratory drilling in the Oligocene-Miocene trend resulted in substantial Frio formation gas and gas-condensate discoveries at La Encantada and West Pita fields.

Brown.—An 8-percent rise in total mineral value resulted from moderate increases in crude oil, natural gas, and stone output. A success ratio of 33 percent was reported for oil and gas exploratory drilling, with discovery of five new gasfields or oilfields in the Marble Falls formation in the Bend Arch area. Clay mined from open pits near Brownwood was used in manufacturing building brick and heavy clay products by Texas Brick Co. Limestone was quarried and crushed by G. C. McBride, Inc., for roadstone, concrete aggregate, riprap, and railroad ballast. A 1,000-barrel-per-day lubricating-oil plant was completed at Bangs by Lube-Tex Corp., a subsidiary of Liberty Petroleum Co.

Burnet.—Increased demand for dimension granite and crushed granite, marble, and limestone resulted in a 79-percent increase in mineral value. Dimension granite for paving block and crushed granite for roadstone and riprap were quarried and prepared by Texas Granite Corp. Southwestern Graphite Co. mined graphite by open-pit methods and processed the ore at its mill 7 miles west of Burnet.

Calhoun.—Mineral value increased 2 percent over 1960 because of improved crude oil, natural gas, and natural gas liquids output. Intensified exploration led to discovery of new gas, gas-condensate, and oilfields in the Frio formation and in Miocene formations at Sea Drift, Northwest Panther, Espiritu, and two unnamed fields. Two new gasoline plants were largely responsible for increased natural gas liquid output; they were the semiautomatic 20-million-cubic-foot-per-day Calhoun plant of Sunray D-X Oil Co., having estimated daily recovery of 18,000 gallons of products, and the 10-million-cubic-foot-per-day North San Antonio Bay processing plant of Cities Service Petroleum Co. Two established processing plants contributed to natural gas liquid recoveries—Heyser plant of Humble Oil & Refining Co. and Point Comfort plant of Aluminum Company of America. Shell used in manufacturing cement and lime was dredged from shallow bays adjoining the county by Bauer Dredging Co. and Smith Brothers Dredging Co. Lime was produced from shell at the alumina refinery of Alcoa. The Point Comfort alumina works and aluminum reduction plant of Alcoa operated on reduced schedules throughout 1961. Ethylene, polyethylene, and other organic derivatives were produced at Seadrift plant of Union Carbide Chemical Co.

Callahan.—Improved crude oil and natural gas production provided a 1-percent increase in total mineral value. Premier Oil & Refining Co. of Texas processed crude oil at its Baird refinery.

Cameron.—A modest increase in natural gas production provided a 2-percent rise in total mineral value; there was little change in the volume of crude oil output. The former Government synthetic fuels plant at Brownsville, idle for several years, was rehabilitated by United Carbon Chemical Corp. as a petrochemical plant to produce acetic acid, acetic anhydrides, and methyl and ethyl ketones. The original plant was designed to convert 90 million cubic feet of gas and 300 million cubic feet of air daily into 6,000 barrels of gasoline, 900 barrels of diesel fuel, and additional quantities of fuel oil and chemicals.

Carson.—Gains in crude oil and natural gas production accounted for a 1-percent rise in mineral value despite lessened output of natural gas liquids. Helium Conservation Corp. was negotiating with the U.S. Department of the Interior for a contract to build a $3 million plant to extract helium from 50 million cubic feet of natural gas a day. Natural gas liquids, down slightly from 1960, were recovered at three established processing plants. Carbon black was recovered at the Schoeber channel plant of Cabot Carbon Co.

Cass.—Declines in value of iron ore and natural gas liquids offset moderate increases in crude oil and natural gas production to register a 3-percent decline in total mineral value. A new 30 million-cubic-foot-per-day gasoline plant, to recover 5,600 barrels of condensate, and an auxiliary 130-long-ton-per-day sulfur recovery facility were being built in Bryans Mill field by Shell Oil Co.; the plant was to augment recovery of natural gas liquids at Lodi processing plant of Breckinridge Gasoline Corp. Brown iron ore was mined from open pits for Sheffield Steel Division of Armco Steel Corp.

Chambers.—Increased production of crude oil, natural gas, and shell offset declines in natural gas liquids and salt production; total mineral value approximated that of 1960. Salt in brine was produced from wells by Diamond Alkali Co. for use in manufacturing chemicals. Shell was dredged from Trinity and Galveston Bays by W. D. Haden Co.; principal uses included concrete aggregate, manufacture of lime used in producing magnesium metal, poultry grit, and filler for asphalt. Natural gas liquids were recovered at Anahuac processing plant of Humble Oil & Refining Co. New facilities added to Winnie plant of Texas Gas Corp. produced 500 barrels per day of heavily concentrated benzene from lighter parts of gasoline fractions.

Cherokee.—Small increases in values of crude oil, natural gas, natural gas liquids, clay, and iron ore were responsible for the 10-percent rise in total mineral value. Brown iron ore was strip mined near Jacksonville by L. B. Haberle and near Rusk by Sheffield Steel Division of Armco Steel Corp. Fire clay was mined from open pits near Troup by General Refractories Co. for use in manufacturing fire brick.

Childress.—Probably the most significant crude oil discovery in the Panhandle in 1961 was also the first crude production in Childress County. This was the oil discovery of the Cisco Reef in the new Kirkland field. Development drilling added four oil wells by yearend.

Clay.—A 2-percent increase in total mineral value resulted from moderate improvements in crude oil, natural gas, natural gas liquids, and stone production. Exploratory drilling resulted in one new oil discovery in the Strawn strata in the Coody field. Ringgold gasoline plant of Otha H. Grimes extracted natural gas liquids from Ringgold gasfield.

Cochran.—Because of decreased natural gas liquid production, total mineral value declined 6 percent. Lehman processing plant of Cities Service Petroleum Co. extracted natural gas liquids from Levelland gasfield.

Coke.—A 2-percent decline in mineral value occurred when combined crude oil and natural gas production increases were less than production declines of natural gas liquids and sand and gravel. Exploration in the Eastern Shelf of the Permian Basin by the oil and gas industry discovered a new, large oil reserve in Pennsylvanian strata in the IAB Northeast field. Two established gas processing plants recovered natural gas liquids during the year.

Coleman.—Increases in value of crude oil and natural gas liquids were responsible for a 3-percent rise in total mineral value. A new 4-million-cubic-foot-per-day gas processing plant of Coker Gasoline Co. supplemented natural gas liquids recovered by three established gas processing plants. Glass and industrial sand were produced from open pits in the Santa Anna Mountains by Santa Anna Silica Sand Co. Miscellaneous clay was mined from open pits for use in manufacturing brick, tile, and heavy clay products by Martin Brick Co.

Colorado.—Improvements in crude oil, natural gas, natural gas liquids, and sand and gravel production were responsible for an 8-percent rise in total mineral value. Natural gas liquids were recovered at a gas processing plant and a cycle plant. Building and paving sand and gravel were prepared from open pits near Columbus, Eagle Lake, Altair, and Glidden by eight producers; paving sand and gravel was prepared for District 13 of Texas Highway Department.

Comal.—Significant declines in values of lime, stone, and sand and gravel contributed to the 15-percent decline in total mineral value. Limestone used in manufacturing lime was quarried near New Braunfels by United States Gypsum Co. Limestone was quarried near Ogden by Servtex Materials Co. for railroad ballast, riprap, concrete aggregate, and soil conditioner.

Comanche.—Combined increases in values of crude oil, natural gas, and stone contributed to a 15-percent increase in total mineral value. Exploratory drilling proved one gasfield in Mississippian strata in an unnamed field. Limestone was quarried and prepared for concrete aggregate and roadstone for District 23 of Texas Highway Department. Miscellaneous clay, used in manufacturing building and face brick, was mined from open pits by De Leon Brick Co.

Concho.—Slight production gains in crude oil and natural gas resulted in a 2-percent increase in total mineral value. An accelerated exploratory drilling program proved many shallow gasfields in Pennsylvanian strata—particularly in the Paint Rock field.

Cooke.—Production gains of natural gas, stone, and sand and gravel were greater than declines in crude oil and natural gas liquids, with a resultant 1-percent gain in total mineral value. Paving sand and gravel and limestone were produced under contract for District 3 of Texas Highway Department; paving gravel was produced by Texhoma Materials Co.

Crane.—Improved output of crude oil, natural gas, and natural gas liquids contributed to a 2-percent increase in mineral value, compared with 1960. Crude oil production was third largest in the State. Five gas processing plants, including a new 40-million-cubic-foot-per-day plant to recover liquids from Judkins and San Angelo lime pays of the Sand Hills area extracted natural gas liquids. Two of the plants had additional facilities to recover sulfur from sour gas—Crane of Phillips Chemical Co. and Waddell of Warren Petroleum Corp.

Crockett.—The 5-percent increase in total mineral value was attributed to modest improvement in mineral fuels production. A probable large gas reserve was materially extended by exploratory drilling in Ellenburger strata of the Lancaster Hill field. El Cinco field, producing from the Devonian strata, had 12 completions at yearend. A 15-million-cubic-foot-per-day gas processing plant was being constructed by Cities Service Petroleum Co. to recover approximately 50,000 gallons of liquid per day from West World and Strawn Ranch pressure maintenance units. Natural gas liquids were recovered at the Todd Ranch processing plant of Continental Oil Co.

Culberson.—Barite was mined from surface deposits 25 miles north of Van Horn and processed at a mill 2 miles east of town. Production gains in petroleum and natural gas supplemented new barite production to account for a 2-percent increase in total mineral value. The oil and gas industry spent 162 crew-weeks in geophysical prospecting; industry drilling projects concentrated on development of existing fields.

Dallas.—Dallas County, with its neighbor, Tarrant County, was the hub of an industrial complex that was resource-oriented regionally and market-oriented nationally. Its industries consumed minerals from both domestic and foreign sources to produce finished products, intermediate products for further processing, and feedstocks that other facilities processed into coproducts or semifabricated units. It was the second ranking metropolitan area in the State.

Substantial reductions in cement, stone, and sand and gravel production accounted for a 14-percent decline in mineral value. Portland and masonry cements were produced from limestone quarried at Cement City by Lone Star Cement Co. and at Eagle Ford by Trinity Portland Cement, Division of General Portland Cement Co. A $1 million, 120-ton-per-day air separation plant was planned by National Cylinder Gas Co., Division of Chemetron Corp., to produce liquid and gaseous oxygen, nitrogen, and argon. Over 3 million tons of sand and gravel was prepared at 16 plants by 12 producers; major uses were building, paving, and roadstone. Miscellaneous clay used in making brick, tile, heavy clay products, and lightweight aggregate was mined near Mesquite by Ferris Brick Co. and near Dallas by Dallas Lightweight Aggregate Corp. Crude perlite mined in adjoining States was expanded at Dallas plants of Texas Lightweight Products Co. and Texas Vermiculite Co. for use as lightweight concrete aggregate, building plaster, and loose fill insulation. Crude oil was refined at the Irving plants of Petroleum Industries, Inc., and Great Western Producers, Inc.

Dawson.—Improved output of crude oil and natural gas compensated for modest declines in natural gas liquids and stone. A total of 57 crew-weeks was spent in geophysical prospecting. Though no significant discovery resulted from exploratory drilling, considerable field development of producing areas was made. Natural gas liquids were recovered at the Lamesa processing plant of Texaco Seaboard, Inc. Limestone was quarried and crushed at open pits near O'Donnell for use as concrete aggregate and roadstone by Lone Star Materials, Inc.

Denton.—The 7-percent increase in total mineral value was occasioned by combined small increases in crude oil, natural gas, and sand and gravel partly mitigated by production losses in clay and stone. A noteworthy exploratory event was the county's first dual gasfield discovery in Pennsylvanian strata of the Fort Worth Basin at the Northwest Justin field. Fire clay used in the manufacture of heavy clay products was mined from open pits near Denton by Acme Brick Co. Contractors furnished paving gravel and limestone for roadstone and concrete aggregate for District 18 of Texas Highway Department.

DeWitt.—Improvement in crude oil, natural gas, stone, and sand and gravel production accounted for a 2-percent increase in total mineral value. A $2.5 million, 63-mile gas gathering system, with a daily capacity of 60 million cubic feet, to connect DeWitt County gas producers with a trunk gas pipeline in Victoria County was being built by Lone Star Gathering Co. Contractors furnished crushed limestone and sand and gravel for concrete aggregate and roadstone for District 13 of Texas Highway Department.

Dickens.—The 47-percent increase in total mineral value was the result of improved outputs of all minerals—crude oil, natural gas, stone, and sand and gravel. Paving gravel was recovered from open pits and sandstone was quarried and crushed by contractors for concrete aggregate and roadstone for District 25 of Texas Highway Department. R. W. Mize mined pit-run gravel for fill.

Dimmit.—A moderate production gain in natural gas nullified a small decline in crude oil output to account for a 1-percent rise in total mineral value. Texstar Petroleum Co. processed crude oil at its Carrizo Springs refinery. Ingersoll Corp. was building a $250,000 gas processing plant to recover 7,000 gallons of liquid a day from the Elaine field.

Donley.—Improved output of all mineral commodities including natural gas, sand and gravel, and stone contributed to a 68-percent increase in total mineral value, compared with 1960. Various producers quarried and prepared 161,000 tons of limestone for use as concrete aggregate and roadstone for District 25 of Texas Highway Department.

Duval.—Gains in natural gas, natural gas liquids, and salt production were responsible for the 3-percent increase in total mineral value; output of crude oil declined slightly. Natural gas liquids were recovered at the Hagist plant of Goliad Corp. and at the Sejita cycling plant of Trinity Gas Corp. Salt in brine was recovered from wells near San Diego for use in manufacturing industrial chemicals by the Chemical Division of Pittsburgh Plate Glass Co. Phillips Petroleum Co. was building a 150-million-cubic-foot-per-day gas processing plant at Freer adjacent to a Coastal States Gas Co. trunk line to recover 85,000 gallons of propane, LP gases, and natural gasoline from gas in the Topeno and Thompsonville fields.

Eastland.—A 9-percent increase in total mineral value resulted from combined increases in natural gas, natural gas liquids, and clay production, nullifying a slight decline in crude oil output. Four processing plants recovered natural gas liquids. Miscellaneous clay, used in manufacturing lightweight aggregate, was mined from open pits near Ranger by Featherlite Corp. and near Eastland by Texas Lightweight Aggregate Co.; fire clay used in manufacturing floor and wall tile was mined near Cisco by Texeramics Co. N. D. Gallagher Clay Products Corp. mined fire clay for pottery.

Ector.—Increased output of crude oil and natural gas compensated for production losses of natural gas liquids, clay, stone, and cement to record a 1-percent rise in total mineral value. Ector County ranked second in both crude oil production and total mineral value. The county was also the center of an impressive petrochemical complex composed of facilities to produce styrene, butadiene, synthetic rubbers, and numerous other organic intermediates. A 65-million-cubic-foot-per-day cycling plant was completed in the Headlee field by Texas Gulf Production Co. Three gas processing plants and two cycling plants recovered natural gas liquids. A waterflood project of 2,000 acres in the 5,600 Upper Clearfork Sand of the Goldsmith field, with an estimated recovery of an additional 7 million barrels of crude, was planned by Phillips Petroleum Co. Carbon black was recovered at the State's largest channel plant by Sid W. Richardson Carbon Co. An $80 million petrochemical plant, associated with the El Paso Natural Gas Products Co. Odessa refinery, was under construction by El Paso Natural Gas Co. and Rexall Drug & Chemical Co. to produce olefins, polyolefins, and chemical derivatives. New facilities included a 150-million-pound-per-year ethylene plant and a 120-million-pound-per-year high pressure polyethylene plastics plant. Future expansion was to include facilities to produce propylene, linear polyethylene, and polypropylene. Curtailed cement production resulted in declines in clay and limestone output. Permian Sand & Gravel Co. quarried and prepared limestone for concrete aggregate and roadstone. Sulfur was recovered from sour gas at six extraction plants associated with natural gasoline plants.

Ellis.—Production from the first full year of operation of the Midlothian cement plant of Texas Industries, Inc., accounted for the increase in total mineral value. Miscellaneous clay was mined from open pits near Ferris by Acme Brick Co. and Ferris Brick Co. for use in manufacturing brick and heavy clay products and from pits near Palmer by Barron Brick Co.

El Paso.—Gains in cement and limestone production accounted for the 2-percent increase in total mineral value. A $1 million gypsum wallboard and building products plant began operations; crude gypsum was mined from open pits near Carlsbad, N. Mex., and trucked to the plant at El Paso. Limestone was quarried and prepared for use in manufacturing portland and masonry cements at the El Paso plant of Southwestern Portland Cement Co. Limestone was quarried and crushed for concrete aggregate and roadstone by McMillan Quarries, Inc., and Vowell Material Co. Industrial and building sand and gravel were prepared by El Paso Sand Products Co. Structural and paving sand and gravel were prepared by contractors for the U.S. Army Corps of Engineers. Copper and lead ores from Western States and from foreign sources were smelted at the El Paso works of American Smelting & Refining Co. The El Paso lead plant was the only market for lead concentrates produced in the midcontinent area since closing the company Federal plant at East Alton, Ill. St. Joseph Lead Co. no longer processed custom ore at its Herculaneum, Mo., smelter. The El Paso lead works operated at reduced capacity during 1961 because of persistent low demand and excessive metal stocks. Electrolytic copper and fire-refined copper were produced from blister copper at the Nichols refinery of Phelps Dodge Refining Corp. A 4-ton-per-hour grinding and processing plant—to treat manganese ores imported from Mexico and used by chemical, brick, and uranium industries—was placed in operation by American Minerals Co.

Erath.—Phillips Petroleum Co. completed a 25-million-cubic-foot per-day gas processing plant to recover 50,000 gallons of liquid a day. Natural gas liquids extracted at the facility were largely responsible for the 83-percent increase in total mineral value.

Fayette.—A 12-percent increase in total mineral value resulted from increased clay and sand and gravel production; crude oil and natural gas output remained stable. Bentonitic clay, used principally in heavy drilling mud for the oil industry, was recovered from open pits by Milwhite Co., Inc., and by Baroid Division of National Lead Co. Building and paving sand and gravel were recovered from pits near LaGrange by Thorstenberg Materials Co. Contractors quarried and prepared limestone and sandstone for roadstone and concrete aggregate for District 13 of Texas Highway Department; paving sand and gravel was also contracted for District 13.

Fisher.—Total mineral value increased 4 percent because of production gains in crude oil, natural gas, and natural gas liquids. Natural gas liquids were recovered at three gas processing plants. Gypsum was mined from open pits near Longworth by Celotex Corp. and from pits near Rotan by National Gypsum Co. The processed ore was used primarily in manufacturing wallboard, plaster, and other building materials.

Fort Bend.—Minerals and mineral fuels, including crude oil, natural gas, natural gas liquids, sand and gravel, stone, salt, and sulfur, contributed to a 2-percent increase in total mineral value. Natural gas liquids were recovered at the Needville processing plant of Industrial Gas Supply Co. Frasch sulfur was recovered from Orchard Dome by Duval Sulphur & Potash Co. and from Long Point Dome by Jefferson Lake Sulphur Co. United Salt Corp. prepared salt in brine and evaporated salt at its Blue Ridge works. Contractors furnished crushed limestone and paving sand and gravel for District 12 of Texas Highway Department. Miscellaneous clay, used in manufacturing lightweight aggregate, was mined from open pits near Missouri City by Texas Lightweight Aggregate Co.

Franklin.—Mineral production dropped 6 percent in total value because of a declining market for natural gas liquids. Tidewater Oil Co. and Texaco Seaboard, Inc., built a 15-million-cubic-foot-per-day cycling plant and a 200-ton-per-day sulfur recovery unit in the New Hope field.

Freestone.—Improved output of crude oil, natural gas, and stone accounted for a 2-percent rise in total mineral value. One shallow gasfield was discovered through exploratory drilling of the Nacatoch formation in North Wortham field. Limestone was quarried and crushed by East Texas Stone Co. for use as concrete aggregate and roadstone; several stone producers quarried and crushed sandstone for use on State highway projects. Teague Brick & Tile Co. mined miscellaneous clay from open pits near Teague for use in manufacturing brick and heavy clay products.

Frio.—Slight production gains in crude oil, natural gas, and sand and gravel resulted in a 2-percent gain in total mineral value. A 20-million-cubic-foot-per-day gas processing plant was being built in the West Big Foot field by Suburban Natural Gasoline Co. Crews of District 15 of Texas Highway Department produced paving gravel.

Gaines.—Gains in crude oil and natural gas production offset declines in natural gas liquids and stone output to register a 1-percent increase in total mineral value. The oil and gas industry added significant crude oil reserves in the Devonian reservoir of the Norman field through exploratory drilling. The county was the fourth largest crude oil producer. Natural gas liquids were recovered at two gas processing plants. Sulfur and carbon black were recovered from sour gas at the Seminole No. 67 plant of Columbian Carbon Co.

Galveston.—Production of crude oil, natural gas, clay, sand and gravel, stone, and Frasch sulfur recorded moderate gains over 1960. Industrial activity in the Galveston and Texas City areas came to a virtual standstill early in September because of wind and water damage from Hurricane Carla. A multimillion-dollar modernization program made the American Oil Co. refinery one of the most modern in the Nation and the fifth largest refinery in the State. New facilities included a 150,000-barrel-per-day crude pipestill, a 48,000-barrel-per-day fluid cat-cracking unit, vacuum distillation units to increase vacuum charge from 33,000 to 62,000 barrels per day, a 14,600-barrel-per-day alkylation unit, and thermal (delayed coking) unit that lessened the charge from 61,800 to 10,500 barrels per day. Benzene capacity of the Texas City refinery of Marathon Oil Co. (formerly Plymouth Oil Co.) was increased from 5 million to 10 million gallons per year. A new 30-million-pound-per-year phenol unit, costing $4 million, was added to the refinery of Texas City Refining Co. Other petrochemical production, not associated with refineries, included synthetic organic chemicals and resins at the Monsanto Chemical Co. plant; acetylene at Linde Co., Division of Union Carbide Corp.; sulfuric acid, synthetic organic chemicals, and polyethylene and vinyl resins at Union Carbide Chemical Co.; and sulfuric acid, fertilizers, sodium silicofluoride, and dicalcium phosphate at Smith-Douglass Co., Inc. Production facilities for ethylene-triamine and tetraethylene-pentamine were expanded at the Texas City plant of Union Carbide Chemical Co. Natural gas liquids were recovered at the Alta Loma gas processing plant of Margaret Hunt Trust Estate. Tin and tungsten ores were smelted at the Texas City smelter of Wah Chang Corp. Frasch sulfur was recovered from High Island Dome near Galveston by U.S. Sulphur Corp. The heating plant and pipelines of this operation were severely damaged during the September hurricane. Shell, used principally in manufacturing cement and as roadstone, was dredged from shallow bays around Galveston by Horton & Horton. Contractors quarried and crushed limestone for concrete aggregate and roadstone for District 12 of Texas Highway Department.

Gillespie.—Production declines in stone, sand and gravel, and talc contributed to a 34-percent decline in total mineral production value. Soapstone was mined at open pits near Willow City and processed at the Llano mill of Southwestern Talc Corp. Rough monumental granite was quarried and prepared at a quarry 4 miles east of Llano by Bear Mountain Quarries. Building and paving sand and gravel were prepared by five producers.

Goliad.—Curtailed crude oil output from prorated wells offset a modest gain in natural gas production to register a 5-percent decline in total mineral value. A 10-million-cubic-foot-per-day refrigerated-absorption gas processing plant to extract 9,600 gallons of liquid per day was built on the main line of Houston Pipeline Co. by Banquete Gas Co. and Houston Natural Gas Production Co. This was the first of five proposed gas processing plants to be built along the Houston Pipeline Co. main gasline.

Gray.—Improvement in mineral fuels production contributed to a 2-percent rise in mineral value. Eight gasoline plants extracted natural gas liquids. Carbon black was produced at three channel plants and one furnace plant. Methyl, ethyl, and butyl acrylates were processed from acetic acid and formaldehyde at the petrochemical plant of Celanese Chemical Co.; these intermediates were used in paint, leather, textile, paper, and other industries.

Grayson.—Mineral production value increased 3 percent as compared with 1960. Limestone was quarried and crushed for use as concrete aggregate, riprap, and roadstone by two producers. Building sand was processed by M&K Sand & Gravel Co.

Gregg.—Small increases in crude oil and natural gas production offset a slight decline in natural gas liquids recovery. The county was third largest oil producer. Natural gas liquids were recovered at four gas processing plants and crude oil was processed at four refineries. One refinery, the Gladewater plant of Gladewater Refining Co., was shut down during 1961. Polypropylene capacity of the Longview plant of Texas Eastman Co. was increased from 20 to 30 million pounds per year as markets and demand for plastic fibers and film improved.

Guadalupe.—Small increases in crude oil, natural gas, and stone output contributed to the 1-percent value increase. Building and paving sand was produced by one operator and crews of District 15 of Texas Highway Department produced paving gravel. Miscellaneous clay was mined from open pits near McQueeney for use in manufacturing brick and heavy products by Acme Brick Co. Limestone was quarried and crushed for use as concrete aggregate and roadstone by one producer.

Hansford.—Increased output of crude oil and natural gas offset a loss in natural gas liquid output for a 1-percent increase in total mineral value. Natural gas liquids were recovered at Phillips Petroleum Co. Hansford and Sherman gasoline plants. Phillips Petroleum Co. contracted with the U.S. Department of the Interior to build a 200-million-cubic-foot-per-day gas processing plant to recover helium for resale to the Government at $10.30 a thousand cubic feet. This plant and one to be built in Moore County were to recover 1 billion cubic feet of helium per year. The helium gas was to be transported in a pipeline to be built by the Government from Bushland, Kans., to the Government Cliffside gas storage field near Amarillo.

Hardeman.—Production losses in crude gypsum and stone were responsible for a 2-percent decline in total mineral value. Limestone was quarried and prepared as concrete aggregate and roadstone by contractors for District 25 of Texas Highway Department. Gypsum was mined from open pits near Acme for use in manufacturing wallboard, plaster, and other building products by Bestwall Gypsum Co.

Hardin.—Improved output of natural gas was the primary cause of a 1-percent increase in total mineral value. Lime used in preparing wood pulp was produced by East Texas Pulp & Paper Co. Sinclair Oil & Gas Co. recovered natural gas liquids at its Nos. 25 and 26 cycling plants.

Harris.—Harris County was an apex of a triangle encompassing a a multi-billion-dollar industrial complex. The chemical and petrochemical segment of the complex utilized natural resources of the Gulf Coast area to produce aliphatic feedstocks, derivatives, and aromatics—including acetylene, methanol, polyethylene, polypropylene, and thermobutylene. These derivatives, in turn, supplied other industries, usually in or near consuming market areas and metropolitan centers, which produced plastics, solvents, fertilizers, nylons, dacrons, and synthetic rubbers and fibers.

The State chemical and petrochemical industry continued new construction and expansion throughout the year. New facilities included a multi-million-dollar complex of Tenneco Chemical Co. on the Houston Ship Channel, including units to produce 100 million pounds of acetylene a year and a plant to supply oxygen for acetylene production. The company planned additional units to produce vinyl chloride monomer, vinyl acetate monomer, ammonia, and methanol. Sinclair-Koppers Chemical Co. completed a 70-million-pound-per-year styrene plant. Using gasoline fractions as raw material, the unit reached capacity production 6 weeks after break-in operations. The styrene monomer was used in manufacturing plastics, synthetic rubber, latex, and polystyrene. Another new styrene plant—the 75-million-pound-per-year facility of Marbon Chemical Division of Borg-Warner Corp.—was to be located adjacent to the Baytown refinery of Humble Oil & Refining Co. The refinery was to supply ethylbenzene to the new chemical plant by direct pipeline. Capacity of the Merichem plant of Jefferson Lake Sulphur Co. was to be expanded to 2,860,000 gallons of cresylic acid. The acid is a chemical intermediate derived from oil refinery byproducts and is used in gasoline, lubricating oil additives, plastics, and solvents. A $15 million, 6-million-pound-per-year, high-density-plastic plant was being built at Houston by National Distillers

& Chemical Corp. Petro-Tex, a joint venture of Tennessee Gas Transmission Co. and Machinery & Chemical Corp., began constructing a multimillion pound unit to produce tetrahydrothalic anhydride for use in the manufacture of plastics and paints and completed a 30-million-pound-per-year maleic anhydride plant early in October.

A $1 million plant to produce dispersions for carbon black in polyethylene with an annual capacity of 8 million pounds per year was planned for the Houston area by Columbian Carbon Co. Diamond Alkali Co. increased its polyvinyl chloride capacity to 75 million pounds per year and began constructing a multimillion dollar acetylene unit at Houston. An ammonia unit was planned as an addition to the company acetylene complex. Diamond Alkali would supply its own hydrogen; nitrogen would be obtained from the new oxygen plant of Linde Co. A $10 million sulfuric acid plant was being added to the La Porte plant of E. I. du Pont de Nemours & Co., Inc. A $5 million vinyl chloride monomer unit was added to the Houston plant of the Ethyl Corp. A $3 million expansion was planned for the Baytown carbon black plant of J. M. Huber Corp. Facilities to increase paraxylene capacity to 105 million pounds annually, to increase orthoxylene capacity, and to double benzene and toluene capacities were being added to the Baytown petrochemical plant of Humble Oil & Refining Co. Facilities to boost annual production of high-analysis fertilizer to 500,000 tons a year were added to the Pasadena plant of Olin Mathieson Chemical Corp. Phillips Chemical Co. raised polyethylene capacity of its Adams terminal plant to 100 million pounds per year. Refinery and petrochemical facilities of Signal Oil & Gas Co. were being expanded under a $5 million program. Chemtron Corp., a major anhydrous aluminum chloride producer, began constructing its third aluminum chloride plant at La Porte. A second aluminum chloride producer—Texas Jersey Manufacturing Co.—completed a 5-million-pound-per-year plant at La Porte. A third aluminum chloride producer—Texas Alkyls, Inc., jointly owned by Stauffer Chemical Co. and Hercules Powder Co.—quadrupled its aluminum alkyls capacity to more than 8 million pounds per year. This impressive production expansion resulted from mounting demand for aluminum chloride and aluminum alkyls for use as catalysts in making styrene monomer, ethylbenzene, and butyl rubber. Styrene and maleic anhydride resin facilities of the Channelview plant, Texas Butadiene & Chemical Corp., were completed during the year. These resins were used as chemical intermediates, as emulsification agents, as pigment dispersants, and in latex paints. A $1.3 million "stainless steel kitchen" for processing special synthetic rubber recipes was added to the Houston plant of Goodyear Tire & Rubber Co. The facility conducted research in styrene-type butadiene synthetic rubbers. Gulf Oil Corp. planned construction of a multimillion dollar, 400-million-pound-per-year ethylene plant, the company's first petrochemical plant not associated with one of its refineries. A $10 million petrochemical plant to produce 50 million pounds of vinyl acetate monomer annually was planned by Reichhold Chemicals, Inc. Facilities to produce alkyl mercaptans were being added to the Houston Plant of Pennsalt Chemicals Corp.

Seven refineries, with combined daily throughput of 115,000 barrels, processed domestic and foreign crude oil. A multimillion dollar petrochemical plant to produce 17 million gallons of benzene annually was put on stream at Pasadena by Crown Central Petroleum Corp. New facilities included a catalytic reformer to boost capacity to 7,500 barrels daily, a 5,000-barrel-per-day Udex unit for producing benzene, toluene, and mixed xylenes, a Tetol unit for converting toluene to benzene, and a xylene splitter for producing orthoxylene. A 60,000-barrel-per-day crude still replacement was being added to the Houston refinery of Sinclair Refining Co., in addition to a 7,600-barrel-per-day catalytic hydrogen treater. Natural gas liquids were recovered at four gasoline plants and two cycling plants. Carbon black was produced from liquid hydrocarbons at the Eldon furnace plant of J. M. Huber Corp. A 1,100-mile products pipeline, varying in diameter from 6 to 12 inches and with a daily capacity of 65,000 barrels, was being built from Mont Belvieu, Tex., to a terminal near Raleigh, N. C., by Dixie Pipeline Co. The company was organized by eight major oil companies—Phillips Petroleum Co., Humble Pipeline Co., Shell Oil Co., Union Texas Natural Gas Corp., Warren Petroleum Corp., Sinclair Pipeline Co., Empire Gas & Fuel Co., and Tuloma Gas Products Co. A second, almost parallel products line was planned by Trans-Continental Gas Pipeline Co. and 10 producing companies, 6 of which were Texaco, Inc., Mobil Oil Co., Continental Oil Co., Atlantic Pipeline Co., Standard Oil Co. of California, and Sinclair Pipeline Co.

Sulfur was recovered from refinery gases at the Baytown refinery by Stauffer Chemical Co., the Deer Park refinery of Shell Chemical Co., and the Houston refinery of Sinclair Refining Co.

A new production line for heat-treating high-strength alloy steel plate began operating in mid-November at the Houston steel mill of Sheffield Division of Armco Steel Corp. The new plant—consisting of hardening and tempering furnaces 800 feet long, controlled by electronic devices regulating temperature, pressure, and time in the furnaces—could produce heat-treated steel plates in finished sizes up to 144 inches wide, 2 inches thick, and 45 feet long at a maximum rate of 16 tons an hour. Growing markets for this type of alloy steel plate included steel structures, storage tanks, oil and gas industry facilities, highway and bridge construction, railroad and mining equipment, tank trucks and transport trailers, television and radio towers, and other fabricated steel products. A $1 million vacuum ladle degasser system for use in steel making was installed at the Houston works of Cameron Iron Works. Foundry capacity of Texas Electric Steel Casting Co. was increased 20 percent with new equipment. Consolidated General Products, Inc., began operating a $5 million aluminum casting and rolling mill that could produce sheet aluminum directly from ingots. New facilities included a 40,000-pound-capacity reverberatory furnace. Molten aluminum alloy from the furnace is fed through casting rolls to make a continuous sheet, 32 inches wide by ¼ inch thick, that is automatically wound into 4,000 pound coils.

Portland and masonry cements were manufactured from shell by Ideal Cement Co., Lone Star Cement Corp., and Trinity Division of

General Portland Cement Corp. A $5 million wet-process cement plant, designed to produce 1.5 million barrels of cement annually, was being built by McDonough Co.; completion was scheduled for 1962. Major equipment included a 450 ft by 12 ft rotary kiln, a 2,000 hp clinker grinding mill, a 1,500 hp raw material grinding mill, pneumatic conveyors, and dust collectors. Crude barite shipped from other States and from foreign countries was crushed and ground for use in heavy drilling mud at the Houston plants of Baroid Division, National Lead Co., and Milwhite Co., Inc. A new 125,000-ton-per-year barite processing plant was completed by International Minerals & Chemical Corp. The plant contained highly automated crushing, milling, and bagging equipment and represented an investment of more than $1 million. Miscellaneous clay was mined near Houston for use in manufacturing brick and heavy clay products by Acme Brick Co., J. M. Cordell & Sons, Inc., and Houston Brick & Tile Co. Lime was manufactured from oystershell at the Pasadena plant of Champion Papers, Inc., for use in paper and fiberboard manufacture and at the Houston steel plant of Sheffield Division of Armco Steel Corp. as a metallurgical flux. Rock salt was mined by United Salt Corp. near Hockley and salt in brine was recovered from wells near Houston by Texas Brine Corp. Building and paving sand and gravel were recovered by four producers and by contractors for District 12 of Texas Highway Department.

Four Texas utility companies—Houston Lighting & Power Co., Texas Power & Light Co., Texas Electric Service Co., and Dallas Power & Light Co.—planned a joint $25 million transmission line to create one of the largest electric power reserves in the Nation. The high-voltage line was to link generating plants having combined capacity of 6.5 million kilowatts. The Houston line was to connect with a line to be built by Texas Electric Service from Fort Worth to the Permian Basin area of west Texas and with a line to be built by Texas Power & Light Co. from Dallas to the Red River.

Harrison.—Production losses from natural gas liquids and clay nullified gains of crude oil and natural gas and total mineral value declined 5 percent. Crude oil was refined at the Waskom refinery of Waskom Natural Gas Corp. and at the Harleton refinery of Hunt Oil Co. Natural gas liquids were recovered at six gasoline plants. Miscellaneous clay and fire clay were mined for use in manufacturing building brick and heavy clay products by Acme Brick Co., Marshall Brick Co., and Marshall Pottery Co. Lignite was strip-mined for use in preparing activated carbon by D'Arco Division of Atlas Chemical Industries, Inc.

Henderson.—Losses in natural gas liquids and clay production accounted for a 3-percent decrease in total mineral value. Most significant crude oil news was the establishment of Fairway as a major oilfield with a potential reserve of more than ½ billion barrels. A mid-1960 strike in the James (Lower Cretaceous) lime, Fairway field extended over more than 20,000 proved acres in southeast Henderson and northeast Anderson Counties, and was the first major field discovery for east Texas since the Neches Woodbine Sand discovery in 1953. Natural gas liquids were recovered at the Trinidad gasoline plant of Lone Star Gas Co. Fire clay mined from open pits by

Harbison-Walker Refractories, Athens Tile & Pottery Co., Texas City Clay Products, Inc., and Athens Brick Co., Inc., was used in manufacturing fire brick, refractory shapes, building brick, and heavy clay production.

Hidalgo.—A 3-percent increase in total mineral value resulted from small increases in natural gas, natural gas liquids, and sand and gravel output. A new liquid mud storage and service facility was opened at Edinburg by Magnet Cove Barium Corp. New facilities consisted of six 500-barrel-capacity storage tanks and one 250-barrel mixing tank. Crude oil was processed at two refineries, and natural gas liquids were recovered at three gas processing plants. Building and paving sand and gravel were recovered from open pits by two producers. Miscellaneous clay was mined near Mission by Valley Brick & Tile Co. for manufacturing brick and heavy clay products.

Hopkins.—Lower value of mineral production resulted from decreased output of natural gas liquids and clays. A new condensate pay in the Smackover formation was discovered in Como field. Fire brick and refractory shapes were manufactured from strip-mined fire clay by A. P. Green Fire Brick Co. of Texas.

Howard.—Advances in all segments of the mineral industry occurred during the year; petroleum accounted for almost 89 percent of the total value. W. R. Grace & Co. announced plans to build a new ammonia plant adjoining the Cosden Petroleum Co. oil refinery in Big Spring; Cosden was to operate the facility. Sid Richardson Carbon Co. completed its carbon black plant near Big Spring. Geophysical prospecting totaled 15 crew-weeks; exploratory drilling was conducted but no significant discoveries were made. Building and paving sand and gravel were produced by West Texas Sand & Gravel Co. and R. E. Janes Gravel Co., Inc.

Hudspeth.—Continuing an upward trend, production of talc and soapstone by seven producers increased. However, because of declines in output of other minerals, total value of mineral production declined 10 percent. Southwestern Portland Cement Co. strip-mined gypsum for use in manufacturing cement. Gifford-Hill & Co., Inc., quarried and crushed rhyolite for roofing granules.

Hutchinson.—The Bureau of Reclamation requested bids for construction of the $96 million Sanford Dam. Located 9 miles northwest of Borger, the multipurpose Canadian River project was to provide municipal and industrial water for 11 cities comprising the Canadian River Municipal Water Authority. Scheduled for completion in 1966, the project would require large quantities of cement, sand and gravel, and stone. A contract for relocating a major gas pipeline that passes through the reservoir site was awarded to Natural Gas Pipeline Co. of America. Cispolybutadiene rubber was produced at the Phillips Chemical Co. Borger plant, only plant producing this material in commercial quantities. Phillips Petroleum Co. announced plans for constructing a crude oil pipeline from southern Beaver County, Okla, to its refinery near Borger. It was estimated that the line would handle about 6,000 barrels of crude and condensate previously transported by truck. Building and paving sand and gravel were produced by two commercial operators.

Jack.—Developments within the mineral fuels industry set a brisk pace during 1961. The county led in discovery of new oil and gas pools with 13 new pools and 6 new pays. The new discoveries produced from Pennsylvanian and Mississippian formations. Fifteen crew-weeks were spent in geophysical prospecting.

Jasper.—The most significant development within the county was awarding of the first clearing contract for McGee Bend Reservoir. The reservoir, scheduled for completion in July 1965, was being constructed by the U.S. Army Corps of Engineers.

Jefferson.—Over the past decade this Gulf Coast county had participated in one of the most sustained periods of growth in mineral and related industries ever recorded in the State. Growth was reflected not only in year-to-year increases in total value of mineral output but also by construction and expansion of resource-orientated industries. In 1961, Pure Oil Co. and Atlantic Refining Co. announced a joint venture to build an aromatics complex at Nederland. The facility would have an annual capacity of 18 million gallons of benzene, 25 million gallons of toluene, and 13 million gallons of xylene. At its Port Arthur refinery, Texaco, Inc., constructed a 12,000-barrel-a-day kerosene hydro-treater unit and planned to build a naphthalene plant with an annual capacity of 100 million pounds. At the Gulf Oil Corp. Port Arthur refinery, a 13,000-barrel unit for lubricating oil feedstocks and a 12,000-barrel delayed-coking unit were under construction. Port Gas Processing Co. was constructing a new plant that would have a capacity of 150 million cubic feet per day. Goodyear Tire & Rubber Co. was constructing a $20 million chemical plant at Beaumont as part of a complex to produce synthetic rubber. Mobil Chemical Co. planned to add a multimillion dollar high-purity benzene plant capable of producing more than 30 million gallons annually to its multiunit chemical complex near Beaumont. Feedstocks for the benzene plant were to come from the 380-million-pound-a-year ethylene plant newly completed by Mobil Chemical Co. Mobil Oil Co. was constructing a 20,000-gallon-a-day delayed-coking unit having a coke-producing capacity of 730 barrels. Tetraeathyl lead was shipped from the new Beaumont plant of Houston Chemical Co. With a rated annual capacity of about 100 million pounds, the completed plant was 50 percent bigger than originally planned. Houston Chemical Co. was constructing an 80-million-pound-per-year ethylene oxide and ethylene glycol plant. Texas Gulf Sulphur Co. recovered Frasch sulfur from Spindletop and Fannett Domes. Sulfur was recovered from refinery gases at the Gulf Oil Corp. Port Arthur refinery, at the new Atreco plant of Atlantic Refining Co., and at the Olin Mathieson Chemical Corp. Beaumont plant.

Building sand was prepared by C. A. McKinley Sons, Inc. Beaumont Brick Co., Inc., mined miscellaneous clay for manufacturing brick and heavy clay products. Salt in brine was produced by Texas Brine Corp.

Jim Hogg.—Discovery of three new oil and gas formations accounted for most of the increase in mineral value. Atlantic Refining Co. completed its Nueces gasoline plant and was building a 100-million-cubic-foot-per-day gas processing plant in the Thompsonville, Northeast field to recover 10,000 gallons of liquids per day.

Johnson.—Limestone for manufacturing lime was quarried by Texas Lime Co. The lime was used principally for building, chemical, and industrial purposes. Various contractors mined and prepared limestone for concrete aggregate and roadstone for Districts 18 and 2 of Texas Highway Department. Aggregate Producers, Inc., produced building and paving sand and gravel. Paving gravel was produced for District 2 of Texas Highway Department by various contractors.

Jones.—There were 13 crew-weeks of geophysical prospecting during the year. Exploration drilling showed a 24-percent-success ratio, resulting in discovery of seven new oilfields in Permian and Pennsylvanian formations. Texas Natural Gasoline Corp. recovered natural gas liquids. Crude oil was refined at the Lueders refinery of Petroleum Products Co. West Texas Stone Co. produced rough architectural and dressed building limestone.

Karnes.—Production of crude oil and natural gas increased; development and exploratory activities continued the brisk pattern set in 1960. Exploratory drilling proved five new oil or gas-condensate fields. A discovery in the Edwards formation in the Hysaw field was 7,000 feet below earlier production. Shell Oil Co. began constructing a $1.5 million plant to recover LP gases and sulfur. When completed, the plant was to process 16 million cubic feet of natural gas daily and recover 13 long tons of sulfur and 19,000 gallons of liquid. The uranium mill of Susquehanna-Western, Inc., processed uranium ores from stockpiles of several producers.

Kleberg.—The world's first oil well to produce simultaneously from six zones—the Santa Gertrudis Grant—was completed by Humble Oil & Refining Co. The well was completed through three strings of production casing with a string of tubing in each. A 258-mile pipeline to transport refined petroleum products from the Baytown refinery of Humble Oil & Refining Co. to San Antonio and Austin was being built by Humble Pipeline Co., an affiliate of Humble Oil & Refining Co. The new system was to have a daily capacity of 17,000 barrels of refined products, primarily motor and aviation fuel. Humble Oil & Refining Co. joined with Lehman Bros., New York investment bankers, to form a new interstate pipeline company to be known as Monterey Gas Transmission Co. Monterey expected to transport more than 700 million cubic feet of gas per day from southwest Texas to Alexandria, La., for sale to United Fuel Gas Co., a principal supplier of gas to other Columbia Gas System companies. Evaporated salt was prepared from sea water by Sea Minerals, Inc. Limestone for concrete aggregate and roadstone was prepared by Heldenfels Bros.

Knox.—New production of sand and gravel and stone accounted for a 4-percent rise in total mineral value. District 25 of Texas Highway Department contracted for paving gravel and miscellaneous stone for use as concrete aggregate and roadstone.

Lamb.—Greater stone production resulted in a 12-percent increase in total mineral value. Limestone was quarried and crushed for concrete aggregate and roadstone by Pioneer Paving.

Lavaca.—Production of crude oil, natural gas, natural gas liquids, stone, and sand and gravel contributed to a 20-percent increase in total mineral value. A 20-million-cubic-foot-per-day gas processing plant to produce propane, butane, natural gasoline, and stabilized condensate was built near Hallettsville. Shell Oil Co. expanded its Provident City gas processing plant from 60 to 80 million cubic feet per day. Natural gas liquids were recovered at the Wilcox gas processing plant of Goliad Corp. Contractors quarried and prepared sandstone, limestone, and paving gravel for District 13 of Texas Highway Department.

Liberty.—Curtailment of crude oil production mostly offset gains in natural gas, natural gas liquids, sand and gravel, and Frasch sulfur production; total mineral value was 3 percent greater than that of 1960. Natural gas liquids were recovered at the Hull plant of Southwest Industries, Inc. Sulfur was mined by the Frasch process from Moss Bluff Dome by Texas Gulf Sulphur Co. Paving sand and gravel and industrial sands were prepared from open pits by Texas Construction Materials Co.

Limestone.—Total mineral value increased 11 percent because of gains in natural gas, clay, and stone production. Miscellaneous clay used in manufacturing building brick and heavy clay products was mined near Groesbeck by Barron Brick Co. Various producers quarried and prepared limestone for roadstone and concrete aggregate for Districts 9 and 18 of Texas Highway Department.

Live Oak.—Natural gas liquids were recovered at two gas processing plants, one of which was new. Atlantic Refining Co. built a 60-million-cubic-foot-per-day processing plant to recover 67,500 gallons of liquids daily. Crude oil was treated at the Three Rivers refinery of Three Rivers Refining Co. Uranium ore was produced from open pits by Susquehanna-Western, Inc.

Llano.—Production losses in stone and feldspar contributed to an 84-percent decline in total mineral value. Dezendorf Marble Co. quarried and prepared marble for use as terrazzo, whiting, and roofing granules. A minor quantity of feldspar was shipped from open pits in the county. Talc and soapstone mined in Hudspeth and Gillespie Counties was ground and prepared at the Southwestern Talc Co. mill. Graphitic schist, used as a filtering medium, was mined from open pits near Llano by Graphilter Corp. Granite was quarried and prepared for dressed monumental stone by Premier Granite Quarries. Texas Crushed Stone Co. quarried and prepared granite for monumental stone and paving block.

Lubbock.—Improvement in sand and gravel output offset losses in crude oil production for a net gain of 14 percent in total mineral value. Caprock Sand & Gravel Co. recovered building and paving sand and gravel from open pits.

Matagorda.—Value of mineral output was a record $43.1 million, 8 percent greater than the 1960 value. The first oil and gas well to produce from seven pays simultaneously was completed in the Blessing field by Texaco, Inc. The record well—No. 1 D. B. McIntosh—comprised four strings of 2⅞-inch tubing and three strings of 1¼-inch tubing, the latter contained in three of the larger diameter strings. Total daily potential was 316 barrels for the two oil zones and 7.5 million cubic feet for the five gas zones. A $15 million petrochemical plant to produce acetyl chemicals was planned for the Bay City area by Celanese Corp. of America. The new facilities were to produce acetaldehyde from ethylene and oxygen in the presence of a catalyst. Natural gas liquids were recovered at three gas processing plants including expanded facilities at the Leabo plant of Tenneco Oil Co. Sun Oil Co. was building an 18-million-cubic-foot-per-day gas processing plant in the Midfield field. Miscellaneous clay was mined for use in making brick and heavy clay products by Pal-Port Clay Products Corp. Shell was dredged from shallow bays surrounding the county by Matagorda Shell Co. District 12 of Texas Highway Department contracted for crushed limestone and paving sand and gravel for concrete aggregate and roadstone.

Maverick.—Total value of mineral output approximated that of 1960. An automatic gas-processing plant with a daily capacity of 2½ million cubic feet to extract 18,000 gallons of liquids daily was under construction in the Sacatosa field by Continental Oil Co. The plant site is on the N. J. Chittim lease, 25 miles east of Eagle Pass.

McLennan.—Improvement in nonmetallic mineral production including cement, clay, limestone, and sand and gravel, was responsible for a 7-percent increase in total mineral value. Universal Atlas Cement Co. completed a $2 million expansion that doubled the capacity of its Waco plant to 2 million barrels. The company mined limestone and clay from open pits near its Waco plant for manufacturing portland and masonry cements. Four producers prepared building and paving sand and gravel from open pits and contractors processed paving gravel for District 9 of Texas Highway Department. A 60,000-cubic-yard-per-year lightweight aggregate plant was being built at Waco by Waco Aggregate Co. Facilities included two rotary kilns, draglines, and crushing and grinding equipment. Shale deposits up to 150 feet thick, with overburden averaging about 3 feet, are on the plant property. Owens-Illinois Glass Co. used glass sand in manufacturing glass containers.

McMullen.—Improvement in crude oil, natural gas, and natural gas liquids production resulted in a 7-percent increase in total mineral value. Sulfur recovery facilities of the Tilden plant of Trans-Jeff Chemical Corp. were expanded to 100 long tons per day of sulfur with additional expansion planned for 1962.

Midland.—Increased production of mineral fuels—crude oil, natural gas, and natural gas liquids—accounted for a 6-percent rise in total mineral value. Natural gas liquids were recovered at four gas processing plants.

Milam.—Total mineral value approximated that of 1960. Lignite was mined from open pits by Industrial Generating Co. and was used as a fuel in generating electric power for the Rockdale aluminum reduction works of Aluminum Company of America; Alcoa operated five of its six potlines during 1961. Paving gravel was recovered from open pits by one producer.

Mitchell.—A 1-percent rise in total mineral value resulted from moderate gains in crude oil, natural gas, and sand and gravel production. Cosden Oil Co. processed crude oil at its Colorado City refinery. Building and paving sand and gravel were prepared from open pits by R. E. Janes Gravel Co., Inc.

Montague.—Value losses sustained in natural gas liquids offset slight increases in natural gas and stone, resulting in little change in total value of mineral output. Bowie Gasoline Co. recovered natural gas liquids at its Bowie plant. Contractors quarried and prepared limestone for concrete aggregate and roadstone for District 3 of Texas Highway Department. Building and paving sand and gravel were prepared from open pits by one producer.

Montgomery.—Jefferson Chemical Co., Inc., added another parazine unit to its Conroe petrochemical plant. Natural gas liquids were recovered at four gasoline processing plants. Carbon black was recovered at the Conroe No. 63 plant of Columbian Carbon Co. District 12 of Texas Highway Department contracted for crushed limestone and paving sand and gravel.

Moore.—Phillips Petroleum Co. contracted with the U.S. Department of the Interior to build two gas processing plants to recover helium for resale to the Government. One plant, with a daily capacity of 275 million cubic feet, was to be built near Dumas in Moore County; the other, of 200-million-cubic-foot capacity, was to be built in Hansford County. Recovered helium would be transported by pipeline to the Government helium gas storage field near Amarillo. Helium was recovered at the Government-operated Exell plant from natural gas. A 160-ton-per-day ammonia unit was being built at the Sunray refinery of Shamrock Oil & Gas Corp. Seven gasoline plants recovered natural gas liquids. Carbon black was produced at the Sunray plant of Continental Carbon Co. Crude oil was processed at the McKee refinery of Shamrock Oil & Gas Corp. Sulfur was recovered from natural gas and refinery off-gases at the McKee gas processing plant of Shamrock Oil & Gas Corp. Prime Western zinc metal was recovered at the Machovec smelter of American Zinc Co. of Illinois; the smelter operated at a reduced rate during the year.

Morris.—New facilities for producing small-diameter black and galvanized pipe were added to the Daingerfield steel mill of Lone Star Steel Co. Auxiliary equipment allowed coating or lining the pipe with newly developed materials such as epoxies or plastics. Other facilities to be built included a spiral-weld pipe mill capable of making 6- to 80-inch-diameter pipe. Early in the first quarter, Lone Star reactivated two open-hearth furnaces, parts of the rolling mill, and steel pipe facilities in the No. 2 electric weld mill. A fourth open-hearth furnace was reactivated about midyear; only one open hearth remained idle. The company mined brown iron ore from open pits as feed for its blast furnace at the Daingerfield mill.

Navarro.—There was little change in total mineral value as improvement in crude oil, natural gas, and stone production offset losses in clay and sand and gravel. Miscellaneous clay produced by Whitselle Brick & Lumber Co. was used in manufacturing brick and heavy clay products. District 18 of Texas Highway Department contracted for limestone and paving gravel for use as concrete aggregate and roadstone.

Newton.—Increases in crude oil and natural gas production were responsible for a 2-percent increase in total mineral value. The first gas processing plant in the county—a 25-million-cubic-foot-per-day unit to recover 168,000 gallons of liquids daily from the Quicksand Creek field—was being built by Oil Reserves Corp.

Nolan.—Moderate declines in natural gas liquids and sand and gravel nullified increased crude oil, natural gas, and cement production and total value of mineral output declined 4-percent. Five gas processing plants recovered natural gas liquids. Gypsum was mined at open pits near Sweetwater by United States Gypsum Co. and by The Flintkote Co. for manufacturing plaster, wallboard, lath, and other gypsum building products. Limestone and clay were mined near Maryneal for manufacturing portland and masonry cements by Lone Star Cement Corp. Hillsdale Gravel Co. produced building and paving sand and gravel for use by the construction industry.

Nueces.—Total mineral value decreased 2 percent as losses in natural gas liquids and lime production offset gains in crude oil, natural gas, clay, cement, shell, and sand and gravel output. A new Hydeal unit, capable of producing 800 barrels of benzene a day, was added to the Suntide Refining Co. oil refinery. Other new facilities were three fractionating towers to produce 330 barrels of ethylbenzene daily and a 15-million-pound-per-year paraxylene unit. New facilities of the Plomo Co. cycling plant in the Brayton field boosted capacity to 85 million cubic feet per day and liquid recovery by nearly 5,000 gallons a day. American Smelting & Refining Co. curtailed zinc production at its electrolytic plant by 11 percent early in 1961 as a result of mounting metal stocks, depressed metal prices, and continued lack of demand for zinc. Robstown Clay Products Co. mined miscellaneous clay from open pits for manufacturing lightweight aggregate. Natural gas liquids were recovered at seven gas processing and four cycling plants. Carbon black was produced at the No. 56 channel plant of Columbian Carbon Co. Shell was dredged from shallow bays in the Corpus Christi area by four producers for use in manufacturing lime and cement and as concrete aggregate. Portland and masonry cements were manufactured from shell and local clays at the Corpus Christi plant of Halliburton Portland Cement Co. Pittsburgh Plate Glass Co. produced lime from shell for construction, industrial, and chemical uses.

Ochiltree.—Improvement in crude oil and natural gas production canceled a decline in natural gas liquid recovery, resulting in little change in total mineral value, compared with 1960. Natural gas liquids were recovered at the Spearman plants of Skelly Oil Co. and Northern Natural Gas Co. A new crude oil pipeline from the Oklahoma Panhandle to Phillips refinery at Borger, with connections for Perryton, North Perryton, West Perryton, Dude Wilson, Share, Southeast Share, and Farnsworth-Conner oilfields in Ochiltree County, was completed by Phillips Pipe Line Co.

Orange.—Mineral output improved 3 percent in value as crude oil, natural gas, natural gas liquids, and cement registered slight production gains. A plant to process 20,000 barrels of gas-condensate gasoline into 800,000 gallons of propane, butane, and related products was planned by Natural Gas Liquids Corp. Methanol capacity of the large petrochemical plant of E. I. du Pont de Nemours & Co., Inc., was increased 35 percent and a new unit to produce 50 million pounds of high density polyethylene and vinyl resin was added during the year. Carbon black was prepared at the new Echo Philblack plant of Phillips Chemical Co. Spencer Chemical Co. produced polyethylene at its Orange works. Portland cement was manufactured from shell and clay at the Echo plant of Texas Portland Cement Co.

Palo Pinto.—Gains in natural gas, natural gas liquids, clay, and sand and gravel production offset a production decline of crude oil to record a 16-percent increase in total mineral value. Natural gas liquids were recovered at the Gordon plant of Lone Star Gas Co. and the Brazos plant of Brazos River Gas Co. Miscellaneous clay, used in manufacturing brick, tile, and heavy clay products, was mined near Mineral Wells by Texeramics, Inc., Texas Vitrified Pipe Co., Reliance Clay Products Co., and Bill Williams Materials Corp. Building and paving sand and gravel were recovered from open pits by Mineral Wells Sand & Gravel Co.

Panola.—Slight gains in crude oil and natural gas production were not enough to offset moderate losses in natural gas liquid production and as a result total value of mineral output decreased 7 percent. Five gas processing plants recovered natural gas liquids.

Parker.—Substantial declines in natural gas liquids and stone production nullified small improvements in natural gas, clay, and sand and gravel production to account for a 5-percent decline in total mineral value. Acme Brick Co. and Mineral Wells Clay Products Co. mined shale from open pits near Bennett for manufacturing brick and heavy clay products. Dimension sandstone and crushed limestone were quarried and prepared by two producers. A 52-mile, 18-inch gas pipeline being built by Lone Star Gas Co. from its Springtown gasoline plant will increase transmission capacity more than 100 million cubic feet of gas daily.

Pecos.—Improved crude oil and natural gas production offset a modest decline in natural gas liquids to cause a 1-percent increase in total mineral value. Natural gas liquids were recovered at the Puckett processing plant of Phillips Petroleum Co. and the Santa Rosa plant of El Paso Natural Gas Co. Limestone was quarried and prepared at open pits for concrete aggregate and roadstone by various producers.

Polk.—Total mineral value increased 4 percent because of increased crude oil, natural gas, natural gas liquids, and stone production. Natural gas liquids were recovered at the Sunshine processing plant of Sunshine Gathering Co. Various operators quarried and crushed sandstone for concrete aggregate, roadstone, and Government-and-contractor use. Special industrial sands were recovered from open pits near Corrigan by Texas Construction Material Co.

Potter.—Gains in natural gas, natural gas liquids, sand and gravel, and helium production were responsible for the 6-percent increase in total mineral value. Natural gas liquids were recovered at the Fain and Turkey Creek processing plants of Amarillo Oil Co. Crude oil was refined at the Amarillo refinery of Texaco, Inc. The U.S. Department of the Interior requested bids on supplying about 400 miles of gas pipe needed to build a helium pipeline from Bushton, Kans., to Amarillo. The pipe would vary from 4 to 10 inches in diameter and withstand pressures up to 1,800 psi. A $1 million 600-gallon-per-day liquid helium facility was being built at Amarillo by Linde Co., Division of Union Carbide Corp. Helium was produced and refined at the Government-operated plant near Amarillo. Building and paving sand and gravel were recovered from open pits near Amarillo by Texas Sand & Gravel Co., Ltd., and Panhandle Gravel, Inc.

Reeves.—Losses in natural gas, natural gas liquids, and clay production resulted in a 22-percent decline in total mineral value despite improved output of crude oil and stone. Deepest in the State, the first Ellenburger gas producer in the Delaware Basin was completed by Gulf Oil Corp. in the Worsham Multipay as the No. 2 Reese Cleveland. Open flow was estimated at 37 million cubic feet of gas per day from perforations at 16,800 to 17,200 feet. Natural gas liquids were recovered at the Tunstill processing plant of Phillips Petroleum Co. and the Ramsey plant of Continental Oil Co. Building sand and gravel was prepared by F. M. Reeves & Sons.

Sabine.—Texas Board of Engineers approved the $54 million Toledo Bend project, jointly financed by Texas and Louisiana. Each State was to furnish $15 million; the remainder was to be raised by revenue bonds, which would be retired by sale of water and electricity generated at the proposed dam. Potential storage capacity of the project was estimated at 4.8 million acre-feet, with a 650-mile shoreline. The lake would cover 181,600 acres, three-fourths in Louisiana.

San Patricio.—Natural gas liquids were recovered at four gas processing plants and one cycling plant. Limestone was quarried and crushed as concrete aggregate and roadstone by Heldenfels Bros. Building and paving sands were prepared from open pits by Fordyce Gravel Co. Reynolds Metals Co. curtailed alumina refining at the Sherwin works and metal production at the San Patricio works at Gregory to adjust production to metal demand; part of the decline resulted from inventory buildups during 1960. The company continued exploring foreign and domestic deposits of alumina, clay, and marginal bauxite and intensified research on new processes for extracting alumina from crude ore. Exploration and drilling in Arkansas, Jamaica, Haiti, and British Guiana improved the company bauxite reserves.

Scurry.—Little change occurred in total mineral value as curtailed crude oil and natural gas liquids output nullified production gains in natural gas and clay. The county ranked sixth in total value of mineral output. Natural gas liquids were recovered at four gas processing plants, one—the Snyder plant of Sunray Mid-Continent Oil Co.—increased capacity from 78 to 81 million cubic feet per day. Southwestern Brick & Tile Co. mined miscellaneous clay for brick and heavy clay products.

Sherman.—Continued gains in natural gas production resulted in a 2-percent rise in total mineral value despite a slight decline in crude oil production. The county was the third largest natural gas producer.

Smith.—Gains in crude oil, natural gas, and clay output equaled natural gas liquids and sand and gravel production declines and total mineral value was virtually unchanged. A $10 million tire plant, to employ 300 production workers and to have an annual payroll of about $2 million, was planned for the Tyler area by Kelly-Springfield Tire Co., subsidiary of Goodyear Tire & Rubber Co. One gas processing plant and one cycling plant recovered natural gas liquids. Crude oil was refined at Tyler refinery of LaGloria Oil & Gas Co. H. J. Ellis Sand Co. produced industrial sand from open pits. Reliance Clay Products Co. mined miscellaneous clay for brick and heavy clay products.

Starr.—A 3-percent increase in total mineral value resulted from increased natural gas and natural gas liquids production that more than offset lower crude oil, clay, and sand and gravel output. Shell Oil Co. completed a 35-million-cubic-foot-per-day gas-processing plant in the North Rincon field. Natural gas liquids were recovered at this plant, at the Rincon plant of Continental Oil Co., and at the Sun cycle plant of Sun Oil Co. Miscellaneous clay mined from open pits was used in manufacturing building and face brick by Valley Brick & Tile Co. Fordyce Gravel Co. produced building and paving sand and gravel. Pumicite (volcanic ash) was mined from open pits by Pozzolana, Inc.

Tarrant.—Tarrant County was an important part of the north-central Texas industrial complex—consisting of cement, metal (fabricated and manufactured), chemical, electrical and transportation equipment, and oil industry supply plants. Total mineral value declined 23 percent because of curtailed cement and sand and gravel production. Crushed limestone and clay were obtained from quarries adjacent to the cement plant of Trinity Division of General Portland Cement Co. for use in masonry and portland cements. Sand and gravel, used principally for building and paving purposes, was produced by 10 operators; contractors prepared paving gravel for District 2 and 18 of Texas Highway Department. Crude oil was refined at the Fort Worth plant of Premier Oil Refining Co. of Texas.

Taylor.—Combined gains of crude oil, natural gas, stone, and sand and gravel offset a production loss in clay to account for a 2-percent rise in total mineral value. Abilene Brick Co. obtained miscellaneous clay from open pits for manufacturing building brick and heavy clay products. Building and paving sand and gravel were prepared by Atlas Sand and Gravel Co., Caton Sand & Gravel Co., and R. E. Janes Gravel Co., Inc. Limestone was quarried and crushed for concrete aggregate and roadstone by H. B. Zachry Co. Crude oil was processed at the Abilene refinery of Petroleum Refining Co.

Terry.—Losses in natural gas liquids output resulted in a 9-percent decline in total mineral value. Two gas-processing plants recovered natural gas liquids. Carbon black was recovered at the Seagraves No. 64 furnace plant of Columbian Carbon Co. Ozark-Mahoning Co. recovered natural sodium sulfate from well brines at its processing plant near Brownfield.

Titus.—A $2.5 million, 6-inch products pipeline was built from the Mt. Pleasant refinery of American Petrofina, Inc., to a terminal at Greensville, near Dallas. Daily capacity of the 133-mile pipeline system was to be 10,000 barrels.

Tom Green.—Combined gains of crude oil, natural gas, and stone resulted in a 5-percent increase in total mineral value, despite losses in natural gas liquids and sand and gravel production. Limestone was quarried and crushed for concrete aggregate, roadstone, and riprap by H. B. Zachry Co. Building and paving sand and gravel were prepared by Montgomery Sand & Gravel Co. Two gas-processing plants recovered natural gas liquids.

Travis.—A 5-percent increase in total mineral value resulted from increased output of sand and gravel; production of stone and lime approximated that of 1960. Limestone was quarried and crushed for concrete aggregate, roadstone, riprap, and metallurgical flux by Texas Crushed Stone Co. and for use in manufacturing lime by Austin White Lime Co. The lime was used principally for building, chemical and industrial purposes, and as a soil conditioner. Texas Quarries, Inc., quarried and prepared dressed building stone. Building and paving sand and gravel were prepared by R. E. Janes Gravel Co., Inc., Capital Aggregates, Inc., and Travis Materials, Inc.

Upton.—A decline in natural gas liquids production was responsible for a 6-percent decrease in total mineral value. Natural gas liquids were recovered at six gasoline plants. Capacity of the Crossett gas-processing plant of Shell Oil Co. was expanded from 3 to 4.5 million cubic feet per day; liquid recovery was increased from 8,300 to 14,800 gallons per day. The first quadruple (two oil-zones and two gas-zones) discovery well in west Texas was completed by Odessa Natural Gasoline Co.

Uvalde.—Total mineral value declined 7 percent because of curtailed production of stone, native asphalt, and sand and gravel. Native asphalt was quarried from pits near Dabney and prepared as road surfacing material by White's Uvalde Mines and from pits near Blewett by Uvalde Rock Asphalt Co. Southwest Stone Co. quarried and prepared basalt for concrete aggregate. Building and paving sand and gravel were prepared by D&D Gravel Co.

Van Zandt.—Curtailed natural gas liquids and salt production resulted in a 1-percent decline in total mineral value; natural gas and crude oil production improved slightly during the year. Natural gas liquids were recovered at the Van processing plant of Pure Oil Co. Salt was recovered from wells and from an underground mine by Morton Salt Co.

Victoria.—Increased output of crude oil, natural gas liquids, and sand and gravel more than compensated for a decline in natural gas production. Total value of mineral output rose 4 percent. A $13 million expansion, including a new 175,000 kilowatt generator, was begun by Central Power & Light Co. at its Victoria plant. Building and paving sand and gravel were prepared from pits by Fordyce Gravel Co., Gulf Materials Co., and Heldenfels Bros.

Waller.—Gains in crude oil, natural gas, natural gas liquids, and stone production were responsible for the 3-percent improvement in total mineral value. Humble Oil & Refining Co. recovered natural gas liquids at its Katy cycling plant. Paving gravel was prepared by crews of Waller County Road & Bridge Department and by District 12 of Texas Highway Department. Limestone was quarried and crushed for concrete aggregate and roadstone for District 12 of Texas Highway Department.

Ward.—Total mineral value approximated that of 1960. Three gas-processing plants recovered natural gas liquids; crude oil was processed at the Wickett refinery of Kent Distributors, Inc. Natural sodium sulfate was recovered from brine and from dry salt beds 9 miles southeast of Monahans by Ozark-Mahoning Co. for preparation of salt cake. Salt in brine was recovered from wells by Montex Chemical Co. Permian Sand & Gravel Co., Inc., prepared building and paving sand and gravel near Grand Falls and mined gypsum from open pits near Pyote.

Webb.—Improved output of crude oil, natural gas, and sand and gravel contributed to the 2-percent increase in total mineral value. Antimony ores and concentrates—imported from Mexico under the barter program of Commodity Credit Corp.—were processed into metal at the Laredo smelter of National Lead Co. Clays imported from Mexico were used in manufacturing building brick and tile at the Laredo plant of Laredo Brick & Tile Co. Building and paving sand and gravel were prepared by Aldape Sand & Gravel Co., Solis Sand & Gravel Co., and Webb Materials, Inc.

Wharton.—Reduced recovery of natural gas liquids was offset by gains in crude oil, natural gas, sand and gravel, and sulfur production to register a 5-percent increase in total mineral value. Tidewater Oil Co. recovered natural gas liquids at its West Bernard processing plant. Sulfur was recovered by the Frasch process from Boling Dome by Texas Gulf Sulphur Co. Paving sand was produced by contractors for District 13 of Texas Highway Department.

Wheeler.—Increases in crude oil, natural gas, natural gas liquids, and stone production resulted in a 4-percent gain in total mineral value. Natural gas liquids were recovered at the McLean-28 processing plant of Warren Petroleum Corp. Carbon black was recovered at the Shamrock furnace plant of United Carbon Co., Inc. Sandstone was quarried for concrete aggregate and roadstone by various producers.

Wichita.—Combined gains of crude oil, natural gas, sand and gravel, and stone compensated for production losses of natural gas liquids. Three gas-processing plants recovered natural gas liquids. Crude oil was processed at two refineries; a third plant, the Wichita Falls unit of Continental Oil Co., was declared obsolete and closed. Continental Oil Co. was building a $2.6 million products pipeline and a refined products storage terminal at Wichita Falls. The new 127-mile, 8-inch-diameter products line, with a capacity of 20,000 barrels per day, was to connect the Wichita Falls terminal with the company's Ponca City, Okla., refinery. Building and paving sand and gravel were prepared by Northwest Materials Co. and Wichita Sand & Gravel Co. Sandstone was quarried and crushed for concrete aggregate and roadstone by various producers for Government-and-contractor use.

Williamson.—Declines in output of dimension and crushed limestone were greater than production gains of lime and limestone used for lime, resulting in a 17-percent decline in total mineral value. Round Rock White Lime Co. and White Stone & Lime Co. quarried and prepared limestone for manufacturing lime. Lime was used for building, chemical, and industrial uses. Rough architectural and dressed building stone was quarried and prepared by Texas Quarries, Inc., San-Tex Stone Quarry, Inc. , and Leander Limestone Corp.

Wilson.—A 2-percent improvement in total mineral value resulted from gains incrude oil, clay, and sand and gravel production. Fire clay, used in heavy clay products, was mined from open pits near Saspamco by W. S. Dickey Clay Manufacturing Co. Paving gravel was produced by crews of District 15 of Texas Highway Department.

Winkler.—Mineral value increased 2 percent because of small gains in crude oil, natural gas, and natural gas liquids production. The county ranked fifth in total mineral value and fifth in value of petroleum output. Seven gas processing plants, two of which were new, recovered natural gas liquids. Texaco, Inc., completed a new 5.5-million-cubic-foot-per-day gas processing plant to recover 7,300 gallons of propane and 17,000 gallons a day of butane. Standard Oil Co. of Texas built a 35-million-cubic-foot-per-day gas processing and condensate stabilization plant to recover 85,000 gallons of liquids per day. Perry Oral Buss was building a 10-million-cubic-foot-per-day processing plant at Winkler. Carbon black was recovered at the Kermit plant of Cabot Carbon Co. The Keystone sulfur recovery plant of Sid Richardson Gasoline Co., adjacent to the company gas-processing plant, was shut down during the year. Gulf Oil Corp. placed in operation the first major one-operator oilfield automation system in the oil industry; a central office at Kermit monitored and tested 148 oil wells in the Keystone field of Winkler County. The 148 wells were linked to 14 "satellite" test stations that were connected to 3 consolidated tank batteries.

Wise.—Gains in crude oil, natural gas, natural gas liquids, and sand and gravel production offset losses in clay and stone output with a resulting 1-percent increase in total mineral value. Three natural gas processing plants recovered natural gas liquids. Miscellaneous clay was mined near Bridgeport for use in building brick and heavy clay products by Acme Brick Co. Crushed limestone for riprap, railroad ballast, metallurgical flux, concrete aggregate, and roadstone was produced by Gifford-Hill & Co. Various producers quarried and crushed limestone for concrete aggregate and roadstone for Districts 2 and 3 of Texas Highway Department. Paving gravel also was produced by contractors for District 2.

Wood.—A 1-percent rise in total mineral value resulted from gains in crude oil and natural gas output. Natural gas liquids were recovered at the Kaska processing plant of Kaska Corp. and at the Hawkins plant of Natural Gasoline Corp. Molding and industrial sands were recovered from pits by Big Sandy Sand Co. and processed at its Upshur County plant.

Yoakum.—Increased production of natural gas and sulfur offset losses in crude oil and natural gas liquid to account for a 1-percent rise in total mineral value. Natural gas liquids were recovered at the Prentice processing plant of Pan American Petroleum Corp. and at the Wasson plant of Shell Oil Co. Frontier Chemical Co. recovered salt in brine from wells near Denver City.

Young.—Total mineral output approximated that of 1960; gains in crude oil and natural gas were offset by losses in natural gas liquids, sand and gravel, and stone output. Natural gas liquids were recovered at three gas processing plants. The Graham refinery of Gratex Corp. was shut down during the year. Building and paving sand and gravel were prepared by Pitcock Brothers. Sandstone and miscellaneous stone were quarried and crushed for concrete aggregate and roadstone by various producers.

The Mineral Industry of Utah

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineralogical Survey.

By M. H. Howes [1]

MINERAL output in Utah in 1961 was valued at $407 million, $24.8 million (6 percent) less than in 1960. Metals accounted for 57 percent of this value, mineral fuels 35 percent, and nonmetals 8 percent. Decreases in values of $12.9 million for metals and $15.6 million for mineral fuels greatly exceeded the comparatively small increase of $3.7 million for nonmetals value.

TABLE 1.—Mineral production in Utah [1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Asphalt and related bitumens, native: Gilsonite short tons	383,037	$10,020	(2)	(2)
Carbon dioxide, natural thousand cubic feet	60,425	4	78,136	$5
Clays thousand short tons	[3] 143	[3] 416	143	1,080
Coal (bituminous) do	4,955	31,458	5,159	31,126
Copper (recoverable content of ores, etc.) short tons	218,049	139,987	213,534	128,120
Fluorspar do	1,912	51	610	18
Gem stones	(4)	72	(4)	73
Gold (recoverable content of ores, etc.) troy ounces	368,255	12,889	342,988	12,005
Iron ore (usable) thousand long tons, gross weight	3,334	23,862	3,533	25,493
Lead (recoverable content of ores, etc.) short tons	39,398	9,219	40,894	8,424
Lime thousand short tons	127	2,672	142	2,626
Natural gas million cubic feet	51,040	9,187	57,175	8,976
Petroleum (crude) thousand 42-gallon barrels	37,594	103,008	[5] 33,118	[5] 91,075
Pumice thousand short tons	60	134	60	95
Salt (common) do	231	3,092	249	3,187
Sand and gravel do	6,848	6,182	14,060	8,448
Silver (recoverable content of ores, etc.) thousand troy ounces	4,783	4,329	4,798	4,435
Stone thousand short tons	1,837	3,087	1,808	3,219
Uranium ore short tons	1,089,757	27,843	1,098,783	25,734
Vanadium do	462	(2)	514	(2)
Zinc (recoverable content of ores, etc.) do	35,476	9,153	37,239	8,565
Value of items that cannot be disclosed: Barite, cement, clays (kaolin—1960), gypsum, molybdenum, natural gas liquids, perlite, phosphate rock, potassium salts, pyrites (1960), and values indicated by footnote 2		36,047		45,554
Total Utah [6]		[7] 431,383		406,617

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Excludes kaolin; included with "Value of items that cannot be disclosed."
[4] Weight not recorded.
[5] Preliminary figure.
[6] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.
[7] Revised figure.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

The decrease in metals values was primarily caused by a decline of $11.9 million in value of the output of copper which continued to be Utah's most important mineral product. Copper alone accounted for 32 percent of the value of all minerals produced in the State. Lesser quantities of gold produced, lower prices for the lead and zinc marketed, and lower metal content in the uranium ore output in 1961 resulted in small declines in values of production of each of these mineral commodities. Iron ore, molybdenum, silver, and vanadium were the only metal commodities showing slight increases in values.

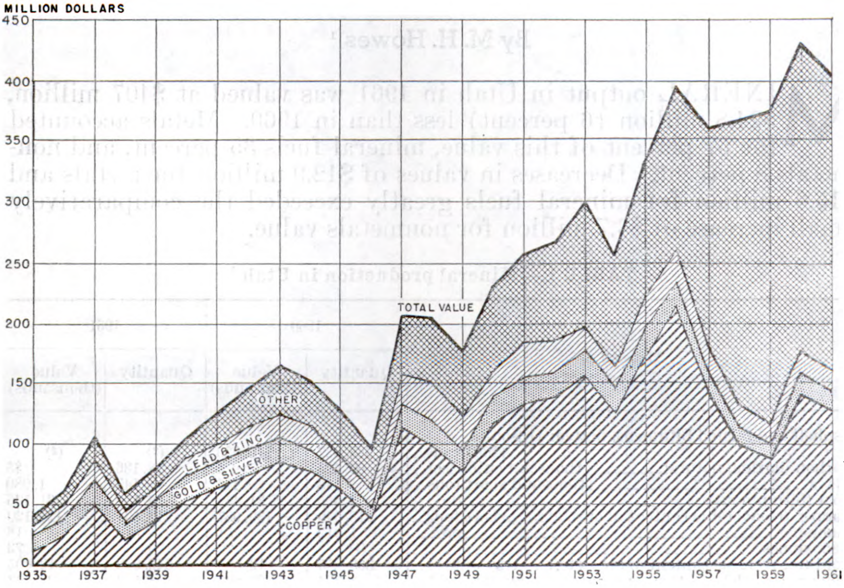

FIGURE 1.—Value of gold, silver, copper, lead, and zinc, and total value of all minerals in Utah, 1935–61.

The total output value for fuels was $15.6 million (10 percent) less than in 1960, primarily because of an $11.9 million decline in the production value for petroleum (crude), which contributed 63 percent of the value of the fuel products. Although more coal was mined in 1961 than in 1960, the value of the output was less. Increases in production values for carbon dioxide and natural gasoline were more than counterbalanced by decreases in output values for gilsonite, natural gas, and liquid petroleum gases.

A gain of $3.7 million (13 percent) in value of the nonmetals products was made in 1961, largely because of an increase of $2.3 million in output value of sand and gravel. The principal products of the nonmetals group were cement, lime, phosphate rock, potassium salts, salt, stone, and sand and gravel. All these products except lime increased in value of production.

Many important events took place in the metal industry during the year. Kennecott Copper Corp. conducted a $5 million rehabilitation project at its Garfield smelter, installing a new materials-handling system. A strike by 188 electrical workers at Kennecott Copper's Utah Copper Division, from August 17 to September 8, caused a shutdown of the mine, mill, and smelter, which idled over 5,000 employees. The Anaconda Company conducted a program of diamond drilling exploration for disseminated copper ore at the Cactus mine and Cerro Verde property in the *Milford* district. Hecla Mining Co. leased the Mayflower Unit of New Park Mining Co. and planned to construct a 400-ton-per-day concentrator near the mine portal. Development work in the Burgin shaft area in the *East Tintic* mining district by Kennecott Copper disclosed a substantial quantity of silver-bearing lead-zinc ore. The uranium ore upgrading plant operated by Union Carbide Nuclear Co. Division, Union Carbide Corp., at Green River was closed February 25.

The secondary recovery of petroleum by waterflooding in the Aneth field was planned to start in December by pumping 80,000 barrels of water per day through 51 injection wells located in a peripheral pattern around the field. On November 7 the new $10 million 20-inch gas-transmission pipeline from the Uintah basin in eastern Utah to Salt Lake City went into operation. The United States Smelting Refining and Mining Co., and Victor Chemical Works Division, Stauffer Chemical Co. announced a joint venture to construct a retort at Midvale for converting bituminous coal to pelleted coke for the metallurgical and chemical industries of the area.

Portland Cement Co. of Utah doubled production capacity at its Salt Lake City plant by a $2.5 million rehabilitation program. San Francisco Chemical Co. successfully completed the first year of operation of its open-pit phosphate rock mine and beneficiation plant near Vernal. Rapid progress was made by Texas Gulf Sulphur Co. in constructing the $30 million Cane Creek potash project near Moab.

Employment and Injuries.—Final employment and injuries data for 1960 and preliminary data for 1961 (excluding the petroleum industry) compiled by the Federal Bureau of Mines are shown in table 2.

Legislation and Government Programs.—The Office of Minerals Exploration (OME) awarded a contract to Glen L. Larsen for $40,550, August 17 to explore for lead, silver, and copper in Juab and Utah Counties.

Of four OME contracts executed in 1960, only the contract with United Park City Mines Co., Salt Lake, Summit, and Wasatch Counties, remained active at yearend 1961. The Brennan Hannifin contract, Juab County, was terminated July 1. No discovery was made on this project. Contracts with Vitro Minerals Corp., Juab County, and Keystone Mining Co., Summit County, were recessed during 1961. Significant discoveries of lead and zinc were made by United Park City Mines and Keystone Mining. The Defense Minerals Exploration Administration (DMEA) contract with New Park Mining Co., Wasatch County, was terminated November 1. Significant discoveries of lead, zinc, and copper ores were made. In October, McFarland & Hullinger completed repayment in full of a DMEA loan from royalties on ore mined in Tooele County.

TABLE 2.—Employment and injuries in the mineral industries[1]

Industry	Number of operations[2]	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Nonfatal	
1960:						
Nonferrous mines and mills (excluding uranium)	52	7,370	16,260,846	5	208	13.1
Uranium mines and mills	219	1,370	2,316,490	4	103	46.2
Ferrous mines and mills	12	439	831,217	--------	4	4.8
Sand and gravel plants	107	390	662,748	--------	18	27.2
Stone quarries and plants	44	404	858,419	--------	5	5.8
Nonmetal mines and mills (other than sand and gravel and stone)	54	519	941,838	--------	51	54.1
Coal (including cleaning plant), asphalt and related bitumens, and coke	57	2,968	5,004,647	6	145	30.2
Total	545	13,460	26,876,205	15	534	20.4
1961:[3]						
Nonferrous mines and mills (excluding uranium)	62	7,128	15,222,518	1	207	13.7
Uranium mines and mills	186	1,071	1,918,765	1	93	49.0
Ferrous mines and mills	11	387	729,944	--------	2	2.7
Sand and gravel plants	104	652	1,178,933	--------	9	7.6
Stone quarries and plants	59	394	795,782	2	5	8.8
Nonmetal mines and mills (other than sand and gravel and stone)	53	480	1,070,837	1	49	46.7
Coal (including cleaning plant), asphalt and related bitumens, and coke	54	3,391	4,599,337	9	141	32.6
Total	529	13,503	25,516,116	14	506	20.4

[1] Excludes petroleum.
[2] Each mine and mill counted.
[3] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Exploration of the Spor Mountain beryllium deposits, about 50 miles northwest of Delta, revealed a substantial tonnage of low-grade material. Among the principal property holders in the area were Vitro Minerals Corp., Beryllium Resources, Inc., and Topaz Beryllium Venture, Inc.

At yearend no successful method of physically concentrating the beryllium mineral in the ore from the Spor Mountain deposit had been perfected, but the beryllium was found to be soluble in various acids. After satisfactory completion of laboratory metallurgical tests, Vitro announced plans to construct a 10-ton-a-day pilot plant in Salt Lake City to test the economic feasibility of extracting a salable product from the ore.

Work on the exploration contract, which Vitro Minerals Corp. executed August 22, 1960, with OME, was suspended during all of 1961 because there was a question of ownership of the contract exploratory area.

Copper.—Utah continued to rank second to Arizona in copper production. A lesser quantity of metal produced and a price per pound of approximately 2 cents less resulted in a decline of 8 percent in the value of copper output. A 21-day labor strike at Kennecott Copper Corp., Utah Copper Division, leading copper producer in the State, was the cause of the lesser output. As published in the Kennecott

Copper annual report, 27.8 million tons of ore was mined and milled from the Utah Copper pit, compared with 28.1 million tons in 1960. Pounds of copper per ton of ore mined was 16.2, the same as in 1960. Total copper produced from all sources was 210,606 tons compared with 215,125 tons in 1960. During the year the new haulage tunnel, opening into the bottom of the pit, was placed in operation.

The United States Smelting Refining and Mining Co. U.S. and Lark mine was the second largest copper producer in Utah.

Over 99.5 percent of the total copper produced came from mined ores and from precipitates of leached copper dumps. The remainder was recovered from various smelter and mill cleanups and from certain copper-bearing uranium ores.

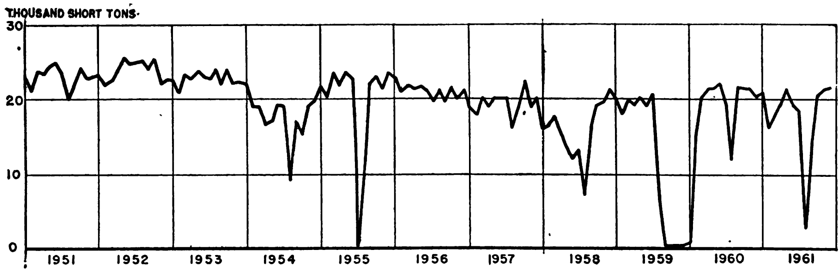

FIGURE 2.—Mine production of copper in Utah, 1951–61, by months, in terms of recoverable metals.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1952–56 (average)	65		30,047	435,915	$15,257	6,584	$5,959
1957	76	1	31,722	378,438	13,245	6,198	5,610
1958	61	2	24,871	307,824	10,774	5,278	4,777
1959	30		20,221	239,517	8,383	3,734	3,380
1960	37		28,832	368,255	12,889	4,783	4,329
1961	34		28,542	342,988	12,005	4,798	4,435
1864–1961			[3] 995,357	16,453,484	476,098	813,830	609,849

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)	249,556	$160,678	47,342	$13,993	36,418	$9,465	$205,352
1957	237,857	143,190	44,471	12,719	40,846	9,476	184,240
1958	189,184	99,511	40,355	9,443	44,982	9,176	133,681
1959	144,715	88,855	36,630	8,425	35,223	8,101	117,144
1960	218,049	139,987	39,398	9,219	35,476	9,153	175,577
1961	213,534	128,120	40,894	8,424	37,239	8,565	161,549
1864–1961	8,392,059	3,310,736	5,111,423	688,104	1,550,697	282,949	5,367,736

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed or tonnage of precipitates shipped.

[3] Figures estimated for certain years before 1901.

TABLE 4.—Mine production of gold, silver, copper, lead, and zinc in 1961, by counties, in terms of recoverable metals

County	Mines producing[1] (lode)	Lode material sold or treated[2] (short tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
Beaver	2	8,024	154	$5,390	12,075	$11,163
Box Elder	2	203	1	35	515	476
Juab	[3] 3	[3] 598	[3] 11	[3] 385	[3] 10,263	[3] 9,488
Millard	(3)	(3)	(3)	(3)	(3)	(3)
Piute	3	2.197	407	14,245	16,322	15,090
Salt Lake	7	28,291,330	333,555	11,674,425	3,745,280	3,462,474
San Juan	(3)	(3)	(3)	(3)	(3)	(3)
Summit	4	79,586	868	30,380	198,812	183,800
Tooele	7	15,525	101	3,535	111,094	102,705
Utah	3	4,717	117	4,095	4,737	4,379
Wasatch	2	134,927	7,774	272,090	698,016	645,309
Washington	1	4,950	------	------	469	434
Total:						
1961	34	28,542,057	342,988	12,004,580	4,797,583	4,435,318
1960	37	28,832,306	368,255	12,888,925	4,782,960	4,328,820

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Beaver	54	$32,460	12	$2,493	235	$54,004	$105,510
Box Elder	------	------	11	2,163	23	5,359	8,033
Juab	[3] 488	[3] 292,740	[3] 43	[3] 8,940	[3] 59	[3] 13,489	[3] 325,042
Millard	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Piute	6	3,780	61	12,597	238	54,924	100,636
Salt Lake	212,379	127,427,640	30,281	6,237,938	25,543	5,874,821	154,677,298
San Juan	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Summit	94	56,220	482	99,261	599	137,770	507,431
Tooele	119	71,370	1,212	249,538	852	196,075	623,223
Utah	3	1,620	4	834	1	242	11,170
Wasatch	314	188,640	8,788	1,810,348	9,688	2,228,136	5,144,523
Washington	77	45,930	------	52	1	150	46,566
Total:							
1961	213,534	128,120,400	40,894	8,424,164	37,239	8,564,970	161,549,432
1960	218,049	139,987,458	39,398	9,219,132	35,476	9,152,808	175,577,143

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines; various uranium mines from which copper was recovered as a byproduct not included as they were in the mine count of uranium.

[2] Excludes tonnage of copper precipitates shipped.

[3] Production of Millard and San Juan Counties combined with Juab County to avoid disclosing individual company confidential data.

Gold.—The decrease of $900,000 (7 percent) in value of gold production below that of 1960 was caused by the decrease in copper production, from which 94 percent of the State gold output was recovered as a byproduct.

The leading gold-producing mines were Kennecott Copper Corp. Utah Copper mine (accounting for most of the output), United States Smelting Refining and Mining Co. U.S. and Lark mine, New Park Mining Co. (Mayflower Lease, lessee) and Hecla Mining Co. Mayflower Unit, and United Park City Mines Co. United Park City mines.

Iron Ore.—Shipments of iron ore were greater by 199,000 long tons (6 percent) in quantity and by $1.6 million (7 percent) in value than in 1960. The entire production came from six mines in Iron County. Columbia Iron Mining Co., a subsidiary of United States Steel Corp.,

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold-silver	3	66,881	422	13,020	663,100	305,500	9,700
Dry silver	6	72,201	738	166,915	172,600	23,300	16,500
Total	9	139,082	1,160	179,935	835,700	328,800	26,200
Copper and uranium [2]	[3] 3	[4] 27,844,693	323,850	2,433,861	403,673,100	900	3,900
Copper-zinc	1	7,751	146	7,868	101,700	----------	439,600
Copper-lead-zinc	2	2,432	31	74,459	164,000	762,000	721,600
Lead	9	1,014	16	14,773	9,800	347,200	65,400
Lead-zinc	18	476,857	17,601	2,060,820	3,502,500	78,828,800	64,882,000
Zinc	4	924	124	7,235	6,800	21,100	242,700
Total	24	28,333,671	341,768	4,599,016	407,457,900	79,960,000	66,355,200
Other "lode" material:							
Gold mill cleanup	(5)	4	1	1	----------	----------	----------
Copper precipitates	1	11,766	----------	----------	18,660,800	----------	----------
Copper-lead-zinc mill cleanup	(5)	2	----------	9	400	300	300
Lead cleanup	(5)	8	----------	5	----------	6,900	----------
Lead smelter cleanup	(5)	211	10	1,547	3,100	26,400	5,300
Lead-zinc cleanup and zinc slag [2]	(5)	69,079	49	17,070	110,100	1,465,600	8,091,000
Total	1	81,070	60	18,632	18,774,400	1,499,200	8,096,600
Total "lode" material	34	28,553,823	342,988	4,797,583	427,068,000	81,788,000	74,478,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Copper mines only; excludes the mine count of uranium mines from which copper was recovered as a byproduct.
[4] Excludes uranium-ore tonnage.
[5] From properties not classed as mines.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in 1961, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation: Ore	1	1	----------	----------	----------
Concentration, and smelting of concentrates:					
Ore [1]	341,537	4,423,542	407,101,200	77,710,100	64,354,400
Cleanings	2	658	100	12,200	14,000
Total	341,539	4,424,200	407,101,300	77,722,300	64,368,400
Direct-smelting:					
Ore	1,391	355,409	1,192,400	2,578,700	2,027,000
Copper precipitates	----------	----------	18,660,800	----------	----------
Cleanings and old slag	57	17,973	113,500	1,487,000	8,082,600
Total	1,448	373,382	19,966,700	4,065,700	10,109,600
Grand total	342,988	4,797,583	427,068,000	81,788,000	74,478,000

[1] Includes uranium ore concentrate.

shipped ore from the Desert Mound and Iron Mountain mines to Columbia-Geneva Steel Division, United States Steel Corp., plants at Ironton and Geneva. Columbia Iron Mining Co. was the leading iron ore producer in the State. Ore from The Colorado Fuel and Iron Corp. (CF&I) Blowout, Comstock, and Duncan mines (mined under contract by Utah Construction & Mining Co.) was shipped to the company plant at Pueblo, Colo. Mine production from Iron Springs (Excelsior) mine, owned by Utah Construction, was shipped to Columbia-Geneva Steel.

TABLE 7.—Usable iron ore shipments

(Thousand long tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952-56 (average)	3,900	$22,599	1960	3,334	$23,862
1957	4,156	30,383	1961	3,533	25,493
1958	3,514	25,202			
1959	2,842	19,979	1906-61	64,031	282,268

Utah Construction completed and placed in operation an iron-ore-beneficiation plant at its Iron Springs mine that will permit better utilization of the ore reserves.

Lead.—Lead output increased 4 percent in tonnage and decreased 9 percent in value. The decline in value was the result of the 10.3-cent average price for lead in 1961, which was 1.4 cents less than in 1960. Lead recovery from lead-zinc ores mined in the U.S. and Lark and Ophir Unit mines and treated in the company flotation mill at Midvale made United States Smelting Refining and Mining Co. the largest lead producer. Other major lead producers were United Park City Mines Co. from its mines in the Park City area, and New Park Mining Co. (Mayflower Lease, lessee) and Hecla Mining Co. from the Mayflower Unit.

In its annual report Kennecott Copper Corp. reported continued development of the silver, lead, and zinc property in the Burgin shaft area in the *East Tintic* mining district. Sinking of the incline shaft was slowed by caving ground, heat, and water. Drilling was continued to indicate additional ore.

United States Smelting Refining and Mining Co. announced in its annual report that work had progressed rapidly on reopening its Butterfield lead-zinc mine. The mine, according to a joint agreement made in August with Kennecott Copper Corp., was to be operated by the company. Access was to be through a raise from a tunnel driven from workings in the adjacent U.S. and Lark mine; ore was expected to be reached by 1963.

The New Park Mining Co. annual report stated that on December 20 the company entered into a working agreement with Mammoth Mining Co. under which New Park obtained exclusive rights to explore and develop claims owned by Mammoth.

Molybdenum.—All the molybdenum produced in Utah was recovered at the Kennecott Copper Corp. Arthur and Magna mills by flotation of copper ore from the Utah Copper mine.

Silver.—A slight increase in production and a rise of 1.9 cents per ounce in the price of silver caused a 2-percent gain in value above that of 1960. A decrease in output of silver at the Utah Copper mine (largest producer in Utah) was surpassed by an increase in production by Cardiff and Kennebec mines (Cardiff Industries, Inc., and Grand Deposit Mining Co.) and Ophir Unit and U.S. and Lark mines (United States Smelting Refining and Mining Co.)

Tungsten.—Closing of the Calvert Creek tungsten mine and mill of Minerals Engineering Co., near Dillon, Mont., was expected to cause a shutdown early in 1962 of the Salt Lake Tungsten Co. (subsidiary of Minerals Engineering) refinery in Salt Lake City.

Uranium.—Production of uranium ore increased 1 percent in tonnage but decreased 8 percent in value, compared with that of 1960. The decline in value of the ore was due to a drop in grade from 0.30 percent (6.0 pounds per ton) in 1960 to 0.28 percent (5.6 pounds per ton).

Processing plants were operated during the year by Uranium Reduction Co. at Moab (1,500-ton-per-day mill); Texas-Zinc Minerals Corp. at Mexican Hat (1,000-ton-per-day mill); and Vitro Chemical Co. Division, Vitro Corporation of America, at Salt Lake City (600-ton-per-day mill). The upgrading plant operated by Union Carbide Nuclear Co. at Green River was closed February 25.

Several lots of surplus equipment were sold during the year at the Government-owned processing mill at Monticello. Sales were conducted by Lucius Pitkin, Inc., AEC contractor. The mill was closed December 31, 1959.

TABLE 8.—Mine production of uranium ore, by counties [1]

County	1960				1961			
	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]
Beaver	3	5,497	20,025	$71,126	1	(3)	(3)	(3)
Emery	47	94,355	463,632	1,913,850	33	89,285	424,472	$1,740,667
Garfield	37	1,641	30,240	142,183	39	1,103	14,695	67,713
Grand	45	43,752	224,454	934,077	59	32,375	171,327	701,551
Juab	1	19,781	76,735	285,638	1	(3)	(3)	(3)
Piute	4	(3)	(3)	(3)	7	(3)	(3)	(3)
San Juan	170	905,845	5,675,076	24,198,450	163	917,558	5,351,951	22,451,157
Sevier	2	(3)	(3)	(3)	--------	--------	--------	--------
Wayne	3	(3)	(3)	(3)	4	923	6,239	26,462
Undistributed	--------	18,886	77,682	297,830	--------	57,539	207,426	746,665
Total	312	1,089,757	6,567,844	27,843,154	307	1,098,783	6,176,110	25,734,215

[1] Based on data supplied to the Bureau of Mines by the AEC.

[2] F.o.b. mine value; base price, grade premiums, and exploration allowance.

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Vanadium.—The quantity of vanadium recovered as a coproduct from uranium ore—produced in Emery, Garfield, Grand, San Juan, and Wayne Counties and processed in mills in southwestern Colorado—was 11 percent more than that in 1960.

The cobalt plant of Calera Mining Co. at Garfield was acquired by Susquehanna-Western, Inc. The plant, operated jointly by Susquehanna-Western, Inc., and Minerals Engineering Co., known as Susquehanna Minerals, was used for producing high-purity vanadium pentoxide from fused ferrophosphorus slags from the Pocatello, Idaho, area. Actual output began in August.

Zinc.—The quantity of zinc produced increased 5 percent, but the value decreased 6 percent, compared with production in 1960. The lower value was due to the drop in annual weighted average price from 12.9 cents in 1960 to 11.5 cents. The leading zinc producers were U.S. and Lark mine and United Park City Mines Co. mines.

MINERAL FUELS

Asphalt and Related Bitumens.—Output of gilsonite (uintahite) increased 10 percent in quantity but decreased 1 percent in value, compared with that of 1960. The entire quantity was produced by American Gilsonite Co. at its Bonanza mines and by G. S. Ziegler & Co. at its Little Bonanza mine, both in Uintah County.

Carbon Dioxide.—Carbon dioxide production came entirely from the the Farnham Dome field in Carbon County. The gas was transported by pipeline to a plant at Wellington where it was converted into dry ice and liquid carbon dioxide.

Coal (Bituminous).—The production of bituminous coal was 4 percent more in tonnage and 1 percent less in value than that in 1960—the average price per ton was $6.03 in 1961 and $6.35 in 1960—and came from 40 underground mines in 5 counties. Carbon and Emery Counties accounted for 76 and 22 percent of the quantity, respectively. Leading producers of coal were Kaiser Steel Corp., Columbia-Geneva Steel, Independent Coal & Coke Co., and United States Fuel Co., a subsidiary of United States Smelting Refining and Mining Co.

TABLE 9.—Coal (bituminous) production, by counties

(Excludes mines producing less than 1,000 short tons)

County	1960		1961	
	Short tons	Average value per ton [1]	Short tons	Average value per per ton [1]
Carbon	3,697,694	$6.50	3,915,881	$6.16
Emery	1,136,786	5.96	1,123,885	5.68
Garfield	1,035	5.50	------	------
Iron	[2] 49,786	[2] 5.04	52,255	4.94
Kane	(2)	(2)	------	------
Sevier	49,310	5.91	47,343	6.13
Summit	20,082	4.42	19,881	4.39
Total	4,954,693	6.35	5,159,245	6.03

[1] Value received or charged for coal f.o.b. mine, including selling cost. (Includes a value for coal not sold but used by producers, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[2] Production of Kane County combined with Iron County to avoid disclosing individual company confidential data.

Natural Gas.—Production of marketed natural gas increased 12 percent in quantity and decreased 2 percent in value compared with that in 1960. Of the total output from fields in seven counties, San Juan contributed 59 percent. Oil-well-gas processing plants, operated by California Oil Co. in Red Wash field, Uintah County; El Paso Natural Gas Co. in Aneth field, San Juan County; and Mountain Fuel Supply Co. in Clay Basin field, Daggett County, supplied 79 percent of all the natural gas marketed. Ten new gasfields were discovered, seven in Uintah County, two in Grand, and one in Duchesne. In addition, 25 development wells, 17 in Uintah and 8 in Grand, were successfully completed.

Natural Gas Liquids.—The quantity of natural gasoline, butane, and propane recovered from plants in Clay Basin field, Daggett County; Red Wash field, Uintah County; and Aneth field, San Juan County, increased over that of 1960. There was a decrease of more than 50 percent in value of output of liquid petroleum gases and a slight gain in value of natural gasoline output. A separation of the liquids recovered at the Aneth plant was made at the Wingate fractionation plant of El Paso Natural Gas Co. at Wingate, N. Mex.

Petroleum.—A drop of 12 percent in both quantity and value of petroleum production occurred from that of 1960; the total output of 33 million barrels came from 807 wells in five counties. The largest decline occurred at Greater Aneth area in San Juan County, where

TABLE 10.—Crude petroleum production, by counties[1]

(Thousand barrels)

County	1960	1961[2]	Principal fields in 1961 in order of production
Duchesne	19	8	Duchesne.
Grand	14	54	Salt Wash, Big Flat.
San Juan	31,929	27,585	Aneth, McElmo Creek, Ratherford.
Uintah	5,630	5,470	Red Wash, Ashley Valley.
Washington	2	1	Virgin.
Total	37,594	33,118	

[1] Based on Utah Oil & Gas Conservation Commission county data, adjusted to Bureau of Mines total.
[2] Preliminary figures.

TABLE 11.—Wildcat- and development-well completions in 1961, by counties

County	Crude	Gas	Dry	Total	Footage
Wildcat:					
Cache			1	1	100
Daggett			1	1	5,500
Duchesne		1	3	4	31,700
Emery			15	15	79,200
Garfield			4	4	23,400
Grand	2	2	12	16	74,900
Millard			1	1	9,000
San Juan	[1] 4		39	43	257,500
Sanpete			2	2	18,100
Sevier			1	1	700
Uintah		7	18	25	172,600
Wasatch			1	1	300
Washington			3	3	2,700
Wayne			3	3	21,500
Total	[1] 6	10	104	120	697,200
Development:					
Grand	2	8	5	15	62,900
San Juan	[2] 58		[3] 13	71	443,800
Uintah	27	17	3	47	273,900
Total	[2] 87	25	[3] 21	133	780,600
Total all drilling	[4] 93	35	[3] 125	253	1,477,800

[1] Includes 1 condensate-well completion.
[2] Includes 2 condensate-well completions.
[3] Includes development service-well completion.
[4] Includes 3 condensate-well completions (1 wildcat, 2 development).

Source: Oil and Gas Journal.

TABLE 12.—Oil and gas discoveries, 1961

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks[1]
			Section	Township	Range				Barrels oil per day	Mcf gas per day		
Duchesne County:												
Badland Cliffs Unit.	No. 2 Unit	Humble Oil & Refining Co.	22	11 S.	14 E.	Mesaverde	5,555- 7,273	7,773		316	Nov. 27	SIGW
Emery County:												
Grassy Trail	No. 1 Unit	Cities Service Petroleum Co.	1	16 S.	12 E.	Moenkopi	3,855- 3,894	7,930	84		Sept. 20	OWWO
Grand County:												
Diamond Ridge	No. 6 Unit	Sunray Mid-Continent Oil Co.	14	17 S.	22 E.	Salt Wash	7,393- 7,408	7,700		970	Aug. 5	SIGW
Bryson Canyon Unit.	No. 2 Unit	Trend Oil Co	10	17 S.	24 E.	Morrison	4,550- 4,945	5,242		1,500	Jan. 15	Do.
Book Cliffs Unit.	No. 1 Unit	Great Yellowstone Corp	32	18 S.	22 E.	do	5,186- 5,244	5,700		4,540	May 17	Do.
Wildcat	Government No. 1	Willard Pease Drilling Co.	3	18 S.	23 E.	do		6,174		1,329	May	Do.
Do	Eppie C. Fee No. 2	Raphael Pumpelly	8	20 S.	24 E.	do	1,284- 1,580	1,587	100		Nov. 1	
Salt Wash Unit	No. 1 Unit	Pan American Petroleum Corp.	15	23 S.	17 E.	Lynch	8,693- 8,707	9,523	115		Apr. 28	
Do	Suniland State A No. 1.	do	16	23 S.	17 E.	Mississippian	8,822- 8,824	8,904	47		Dec. 20	
San Juan County:												
Wildcat	Big Indian USA No. 1.	The Pure Oil Co	33	29 S.	24 E.	do	9,886-10,150	11,132		10,880	Sept. 13	SIGW
Grayson	Clark No. 1	Lion Oil Co. (Monsanto Chemical Co.).	28	38 S.	22 E.	Desert Creek	5,906- 5,928	6,118	166		July 21	
Anido Creek	Navajo 111-1	Champlin Oil & Refining Co.	13	43 S.	24 E.	Mississippian	5,302- 5,346	6,611	2,085		Jan. 4	
Do	Navajo 111-2	do	13	43 S.	24 E.	Desert Creek B	5,360- 5,380	5,561	501		Feb. 10	
Do	Navajo G No. 14-7	Superior Oil Co	7	43 S.	25 E.	Desert Creek	5,198- 5,506	5,506	582		Mar. 19	
Do	Navajo 5 San Juan No. 1.	Sinclair Oil & Gas Co	18	43 S.	25 E.	do	5,308- 5,323	5,433	1,029		Feb. 24	

Uintah County:											
White River Unit.	No. 5 Unit	Belco Petroleum Corp.	35	8 S.	22 E.	Wasatch	5,904– 6,234	6,500		969	Dec. 7	SIGW
Ute Trail Unit	No. 4 Unit	DeKalb Agricultural Assn., Inc., and DeKalb Petroleum Corp., U.S. Oil Division.	27	9 S.	20 E.	do	6,205– 6,310	8,557		1,000	June 6	SIGW deepened.
Do	No. 12 Unit	do	29	9 S.	21 E.	do	4,980– 6,057	6,506		1,500	Dec. 31	SIGW
Do	No. 10 Unit	do	34	9 S.	21 E.	do	4,938– 5,393	6,051		7,000	Oct. 25	Do.
Do	No. 9 Unit	do	6	10 S.	22 E.	do	5,018– 5,636	5,705		24,000	Aug. 8	Do.
Island Unit	No. 2 Unit	Mountain Fuel Supply Co.	14	10 S.	18 E.	Mesaverde	7,078– 7,102	8,103		1,140	May 13	Do.
Uintah Unit	No. 3 Unit	DeKalb Agricultural Assn., Inc., and DeKalb Petroleum Corp., U.S. Oil Division.	12	10 S.	20 E.	Wasatch	5,540– 5,780	6,505		5,300	Nov. 12	Do.
Do	No. 4 Unit	do	23	10 S.	21 E.	do	4,070– 5,596	6,506		1,200	Dec. 16	Do.
Wildcat	Hendel No. 1	Phillips Petroleum Co.	23	10 S.	18 E.	do	5,840– 5,851	6,701		793	Apr. 25	Do.
Do	Bitter Creek No. 1	DeKalb Agricultural Assn., Inc, and DeKalb Petroleum Corp., U.S. Oil Division.	34	10 S.	22 E.	do	4,070– 5,036	5,486		8,000	Nov. 18	Do.
Rainbow Unit	No. 1 Unit	Shamrock Oil & Gas Corp.	8	11 S.	24 E.	do	2,960– 5,458	6,569		1,500	Nov. 6	Do.
						Mesaverde				3,060		DC
Wildcat	Government 1-15	Delhi-Taylor Oil Corp.	15	12 S.	21 E.	do	4,924– 5,050	6,528		6,200	Sept. 9	SIGW

[1] SIGW—Shut-in gas well; OWWO—old well workover; DC—dual completion.

Source: Utah Oil & Gas Conservation Commission.

rapid reservoir-pressure drops were recorded. Secondary recovery by waterflooding was started in December in the Aneth field. It was planned to pump 80,000 barrels of water per day through 51 injection wells located in a peripheral pattern around the field. With four units operating in the Greater Aneth area, the flood was to cover 64,500 acres containing 520 wells and was expected to double the predicted primary recovery of 119.3 million barrels of oil.

Exploratory drilling increased and development drilling decreased with completion of 120 exploratory and 133 development wells, compared with 96 and 147 holes, respectively, in 1960. Six discoveries in exploratory drilling were made, four in San Juan County and two in Grand County. Thirteen percent of the exploratory holes and 85 percent of the development holes were successful; 51 percent of all drilling was successful.

Four refineries operated in the Salt Lake City area: Phillips Petroleum Co., Woods Cross; California Oil Co. (formerly Salt Lake Refining Co.), Salt Lake City; American Oil Co. (formerly Utah Oil Refining Co.), Salt Lake City; and Beeline Refining Co. Division, Frontier Refining Co. (formerly Western State Refining Co.), North Salt Lake City. Total throughput was 31.6 million barrels of crude oil, 1 percent more than that in 1960.

NONMETALS

Barite.—Barite production dropped 18 percent in tonnage and 17 percent in value below that for 1960. D. J. Garrick, Juab County, was the only producer. The crude product was ground in a Salt Lake City plant operated by Custom Milling & Supply Co. and then sold to the oil-well drilling industry.

Cement.—Increases of 11 percent in quantity and 12 percent in value of the production of cement over that in 1960 were due to more building and highway construction. Ideal Cement Co. at Devil's Slide, Morgan County, continued to be the major producer. Cement from this plant was being used in construction of the Flaming Gorge dam, which was scheduled for completion late in 1962. Portland Cement Co. of Utah, the only other producer, doubled production capacity of its Salt Lake City plant by an expenditure of $2.5 million in anticipation of increased demand for cement in the intermountain area. This expansion was achieved by installing a new 10- by 300-foot rotary kiln, an 11½- by 17-foot ball mill, a new dust collector, a control center, a 90-foot truck scale, and improved loading apparatus.

Clays.—Clays, excluding halloysite (kaolin), decreased 26 percent in quantity and 18 percent in value of production from that in 1960. Halloysite quantity and value of output also were lower. The Filtrol Corp., operator of the Dragon halloysite mine in Juab County, continued to be the largest clay producer in the State. Nearly all the fire clay and miscellaneous clay was produced and processed by Interstate Brick Co. and Gladding, McBean & Co. All the bentonite and fuller's earth was mined in Sevier County by Western Clay & Metals Co. and Macco Corp.

Fluorspar.—Output of fluorspar decreased 65 percent in value from that in 1960. Willden Bros. at Lost Sheep mine, Chesley & Black at Fluorine Queen mine, and United Technical Industries, Inc. (company name changed from Larsen Industries, Inc.) at Bell Hill mine, all in Juab County, were the producers. The upgraded mine-run product (metallurgical grade) was used in steel and cement manufacturing and in iron foundries.

Gem Stones.—The value of gem stones, collected from 18 of the 29 counties, was 1 percent more than that in 1960. Varieties of gem materials collected in most abundance were agate, petrified wood, obsidian, jasper, and geodes.

Gypsum.—Gypsum production declined 7 percent in value from that in 1960. Bestwall Gypsum Co. and United States Gypsum Co. mined gypsum and operated wallboard plants in Sevier County, near Sigurd.

Lime.—Lime production increased 12 percent in quantity and decreased 2 percent in value, compared with that of 1960. Seventy-three percent of the lime produced was quicklime; the remainder was hydrated lime. Most of the output was consumed in Utah, particularly in the copper and iron industries, but 15 percent of the total production was shipped to California, Colorado, Idaho, Montana, Nevada, Oregon, Washington, Wyoming, and Canada.

Perlite.—Production of crude and expanded perlite remained essentially the same as in 1960. Crude perlite was mined in Beaver County and expanded in Salt Lake City by Acme Lite-Wate Products, Inc. Perlite produced in Nevada was expanded by Bestwall Gypsum Co. at Sigurd.

Phosphate Rock.—The production value of phosphate rock increased 35 percent over that of 1960. Two properties were operated by San Francisco Chemical Co.: the Cherokee phosphate rock mine near Randolph in Rich County and a deposit in the Brush Creek area, 12 miles north of Vernal, in Uintah County. Production from the Cherokee mine was milled at Sage, Wyo., and production from the Brush Creek deposit was milled at Vernal. Production from the Brush Creek deposit was used in manufacturing agricultural fertilizer; production from the Cherokee mine was used in manufacturing agricultural fertilizers and phosphoric acid.

Potash.—The production value of potassium salts from the works of Bonneville, Ltd., at Wendover was 25 percent greater than in 1960. The company annual report for the year ending June 30, 1961, stated that the increase was the result of higher potash prices and larger tonnage. Brine recovery was increased by digging new collecting ditches, increasing the capacity of seven deep brine wells 50 percent by installing larger pump motors, deepening the primary ditches, and lowering the large primary pumps 6 feet. The mill was placed on almost continuous operation (about 350 days per year compared with 286 days per year in the past).

The $30 million potash project at Cane Creek, 15 miles southwest of Moab, operated by Texas Gulf Sulphur Co., progressed rapidly. Project completions by the end of 1961 included 50 percent of the 36-mile railroad spur and tunnel; 85 and 30 percent of the concrete headframe and concrete-lined 22-foot-diameter 2,800-foot-deep shaft, respectively; 45 percent of the 7.2-mile river-access road; 65 percent of the surface-plant-site grading; and nearly all the machine shop, warehouse, and product-storage buildings.

Pumice.—Although pumice (volcanic cinders and scoria) output was virtually the same as in 1960, the value was 29 percent less. The entire production, by Melvin Bradshaw in Beaver County, and Central Block Co., Christensen Construction Co., and Ralph Memott in Millard County, was used as concrete aggregate in manufacturing building block and other structural products.

Pyrites.—No shipments of pyrites were recorded. Adequate quantities of byproduct sulfur dioxide gas from the Garfield copper smelter satisfied the demand for manufacturing sulfuric acid by Garfield Chemical and Manufacturing Corp., jointly owned by Kennecott Copper Corp. and American Smelting and Refining Co. (Asarco), at its Garfield acid plant.

Salt.—An increase of 3 percent over that of 1960 was recorded in the value of salt production; 87 percent of the salt was produced by solar evaporation of brine from Great Salt Lake. Morton Salt Co. in Salt Lake County was the major producer. Leslie Salt Co., Utah Salt Co., and Solar Salt Co. in Tooele County and Lake Crystal Salt Co. in Box Elder County also produced solar-evaporated salt. Morton Salt Co. in Sanpete County and Poulson Brothers Salt Co. in Sevier County operated rock-salt mines near Redmond. Salt from these two mines was used for stock feed.

Sand and Gravel.—Sand and gravel production was 105 percent more than in 1960. Fifty-seven percent of the output was used in road construction and 21 percent in building. Fifty-eight commercial and 45 Government-and-contractor pit operations were active—1 more than in 1960. All the counties in the State produced sand and gravel except Grand, Juab, Kane, and Piute. The major producing counties, each with an output of over 1 million tons, were Salt Lake, Box Elder, Morgan, Summit, and Emery. Together, these counties were responsible for 73 percent of the tonnage sold or used.

A report[2] showed that from July 1, 1956, to December 31, 1961, Utah completed to full or acceptable interstate highway standards 57.1 miles of road and improved 18.2 miles to standards adequate for present traffic, for a total of 75.3 miles open to traffic. The State ranked 41st on the basis of this mileage. However, in view of the 317.8 miles of highway under construction and undergoing engineering procedure or right-of-way acquisition Utah ranked 16th in the progress on the Interstate System.

Stone.—The value of stone production increased 4 percent over that of 1960. Crushed limestone constituted 90 percent of the total stone output. More than one-third of the crushed limestone was used for manufacturing cement; other principal uses were as a flux in smelting and for manufacturing lime. Other types of stone produced, in order of value, were crushed sandstone, dimension sandstone, crushed miscellaneous stone, crushed marble, and dimension limestone.

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[2] Bureau of Public Roads, Quarterly Report on the Federal-Aid Highway Program: Dec. 31, 1960, press release BPR 62–4, Feb. 7, 1962.

TABLE 13.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Construction sand:				
Building	794	$791	843	$854
Paving	318	252	274	243
Fill	14	7	21	10
Other	24	21	20	20
Industrial sand:				
Molding	23	39	3	10
Blast	1	3	(1)	(2)
Fire or furnace			20	24
Engine			1	3
Total sand	1,174	1,113	1,182	1,164
Construction gravel:				
Building	959	981	1,296	1,322
Paving	2,625	1,919	5,347	2,245
Railroad ballast	24	6	(3)	(3)
Fill	56	25	65	42
Other	42	79	30	25
Miscellaneous gravel	15	13	(3)	(3)
Total gravel	3,721	3,023	6,738	3,634
Total sand and gravel	4,895	4,136	7,920	4,798
Government-and-contractor operations:				
Sand:				
Building	83	167	206	194
Paving	53	43	15	9
Fill			1,437	240
Total sand	136	210	1,658	443
Gravel:				
Building	343	684	640	649
Paving	1,474	1,152	2,312	1,999
Fill			1,511	537
Other			19	22
Total gravel	1,817	1,836	4,482	3,207
Total sand and gravel	1,953	2,046	6,140	3,650
All operations:				
Sand	1,310	1,323	2,840	1,607
Gravel	5,538	4,859	11,220	6,841
Grand total	6,848	6,182	14,060	8,448

[1] Less than 500 short tons.
[2] Less than $500.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Other."

TABLE 14.—Stone production in 1961, by counties

County	Short tons	Value	County	Short tons	Value
Beaver	6,339	$26,503	Tooele	259,399	$667,304
Box Elder	60	75	Uintah	17,320	37,360
Cache	57,266	197,567	Utah	(1)	(1)
Davis	488	610	Wasatch	26,234	44,105
Garfield	4,739	45,900	Washington	18	3,160
Iron	725	10,375	Wayne	16,279	105,300
Juab	(1)	(1)	Weber	28,500	14,250
Millard	(1)	(1)	Other counties	1,273,823	1,882,554
Morgan	(1)	(1)			
Salt Lake	(1)	(1)	Total	1,807,918	3,218,734
Summit	116,728	183,671			

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other counties."

TABLE 15.—Stone sold or used by producers, by kinds

Year	Granite		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value
1957					1,723,300	$2,359,600
1958	77,300	$146,100			2,958,000	3,648,900
1959	1,500	1,500			1,547,600	2,196,400
1960	1,200	1,200			1,702,021	2,921,737
1961			639	$3,703	1,621,128	2,815,852

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1957	123,175	$155,150	6,007,400	$6,025,300	7,853,875	$8,540,050
1958	10,090,877	10,153,414	200	200	13,126,377	13,948,614
1959	1,786,186	1,834,808	2,600	15,700	3,337,886	4,048,408
1960	76,158	118,615	57,500	45,312	1,836,879	3,086,864
1961	126,470	329,405	59,681	69,774	1,807,918	3,218,734

TABLE 16.—Stone sold or used by producers, by uses

Use	1960		1961	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction ... short tons	903	$20,929	590	$13,400
Rubble ... do			3,000	86,000
Sawed stone ... cubic feet	(1)	(1)	(1)	(1)
Dressed stone ... do	(1)	(1)	(1)	(1)
Flagging ... do			[2] 2,564	7,000
Other ... do	[3] 13,090	16,500	[4] 13,372	46,202
Total dimension stone (approximate, in short tons)	1,924	37,429	4,833	152,602
Crushed and broken stone:				
Riprap ... short tons	63,532	121,000	186,229	386,119
Metallurgical ... do	679,492	1,101,192	606,114	876,396
Concrete and roadstone ... do	135,162	113,665	(1)	(1)
Chemical ... do	58,136	200,684	(1)	(1)
Other ... do	[5] 898,633	[5] 1,512,894	[6] 1,010,742	[6] 1,803,617
Total crushed and broken stone ... short tons	1,834,955	3,049,435	1,803,085	3,066,132
Grand total (approximate, in short tons)	1,836,879	3,086,864	1,807,918	3,218,734

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Other."
[2] Approximately 200 short tons.
[3] Approximately 1,021 short tons.
[4] Approximately 1,043 short tons
[5] Includes stone used in railroad ballast, asphalt filler, coal dust, poultry grit, cement, lime, landscaping, and roofing granules.
[6] Includes stone used in railroad ballast, concrete and road metal, chemical, asphalt filler, coal dust, poultry grit, cement, lime, landscaping, roofing granules, explosives, building chips, and filter rock.

Sulfur.—Sulphurdale Chemical Co., successor to American Sulphur and Refining Co., was building at Sulphurdale, Beaver County, a 100-ton-per-day mill to produce powdered and beaded sulfur for sale to industrial users in northern Utah.

Talc.—Crude talc mined in California and Montana was ground by Tri-State Minerals Co. at its mill in Ogden. The ground material was used by producers for manufacturing paint, ceramics, paper, toilet preparations, insecticides, and textiles, and for polishing rice.

Vermiculite.—Vermiculite-Intermountain, Inc., continued operating its Salt Lake City exfoliating plant. Ground material was shipped from mines in Montana. Most of the finished product was sold for insulation.

REVIEW BY COUNTIES

Beaver.—Value of mineral production increased 39 percent over that of 1960. All mineral commodities except lead and uranium ore increased in quantity and value of output. The metals—gold, silver, copper, lead, zinc, and uranium ore—represented more than one-half the total value of mineral output. Creole Mining Co. and Index-Daley Mines Co., operators of the Creole mine in the *Lincoln* mining district, were the county's largest producers of gold, silver, copper,

TABLE 17.—Value of mineral production in Utah, by counties

County	1960	1961 [1]	Minerals produced in 1961 in order of value
Beaver	$156,164	$217,288	Zinc, copper, uranium ore, stone, sand and gravel, pumice, silver, perlite, gold, lead, gem stones.
Box Elder	607,470	1,208,018	Sand and gravel, lime, salt, zinc, lead, gem stones, silver, stone, gold.
Cache	512,545	557,837	Sand and gravel, stone, lime.
Carbon	[2] 26,233,362	25,721,209	Coal, natural gas, sand and gravel, carbon dioxide, gem stones.
Daggett	[2] 1,178,242	1,191,900	Sand and gravel, natural gas, natural gasoline.
Davis	293,000	381,220	Sand and gravel, stone, gem stones.
Duchesne	442,881	26,600	Petroleum, sand and gravel.
Emery [3]	[2] 8,788,173	8,625,591	Coal, uranium ore, sand and gravel, natural gas, gem stones.
Garfield [3]	175,650	216,043	Sand and gravel, uranium ore, stone, gem stones.
Grand [3]	[2] 1,211,689	1,422,180	Uranium ore, natural gas, petroleum, gem stones.
Iron	24,141,028	(4)	Iron ore, coal, sand and gravel, stone.
Juab	1,545,568	1,237,893	Clays, uranium ore, stone, gem stones, fluorspar, barite, lead, silver, zinc, copper, gold.
Kane	8,082	(4)	Gem stones.
Millard	149,779	123,588	Pumice, sand and gravel, stone, zinc, gem stones, lead, silver.
Morgan	7,117,922	7,625,871	Cement, sand and gravel, stone.
Piute	313,144	(4)	Uranium ore, zinc, silver, gold, lead, copper.
Rich	2,235,102	1,914,256	Phosphate rock, sand and gravel.
Salt Lake	[2] 188,507,858	177,208,701	Copper, molybdenum, gold, lead, zinc, silver, cement, sand and gravel, salt, stone, lime, gem stones.
San Juan [3]	[2] 122,701,022	106,781,428	Petroleum, uranium ore, natural gas, LP gases, natural gasoline, copper, sand and gravel, silver, gem stones, zinc, lead.
Sanpete	[2] 142,482	145,221	Sand and gravel, salt, clays, natural gas.
Sevier	1,333,843	1,290,559	Gypsum, coal, clays, sand and gravel, salt, gem stones.
Summit	4,756,976	1,639,948	Sand and gravel, silver, stone, zinc, lead, coal, copper, clays, gold.
Tooele	6,095,561	6,897,300	Potassium salts, lime, salt, stone, lead, zinc, silver, clays, copper, sand and gravel, gold, gem stones.
Uintah	27,139,151	28,085,937	Petroleum, gilsonite, natural gas, phosphate rock, sand and gravel, natural gasoline, stone, gem stones.
Utah	1,928,367	1,474,465	Stone, sand and gravel, lime, clays, silver, gold, gem stones, copper, lead, zinc.
Wasatch	[2] 2,432,607	5,237,028	Zinc, lead, silver, gold, copper, sand and gravel, stone.
Washington	92,854	225,501	Sand and gravel, copper, stone, petroleum, gem stones, silver, zinc, lead.
Wayne [3]	5,593	136,862	Stone, uranium ore, gem stones, sand and gravel.
Weber	[2] 593,140	551,758	Sand and gravel, clays, stone.
Undistributed [5]	[2] 1,871,978	28,113,145	
Total [6]	[2] 431,383,000	406,617,000	

[1] Value of petroleum is preliminary.
[2] Revised figure.
[3] Excludes vanadium.
[4] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[5] Includes vanadium and some sand and gravel and gem stones, and values indicated by footnote 4.
[6] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

and zinc. Bellevue Mines and Harrington Mines Co., operators of the Harrington-Hickory mine in the *Milford* mining district, produced lead. The Mystery Sniffer mine was the only uranium property operated.

The only crude perlite produced in the State was mined by Acme Lite-Wate Products, Inc., in the North Pearl Queen quarry near Milford. The product was shipped to the company plant in Salt Lake City, where it was expanded for use in plaster, concrete, and as a soil conditioner. Stone quarrying, inactive during 1960, was resumed in 1961. Henry Shoo mined and crushed marble for use as building chips, and Stratton Brothers produced crushed stone for use as riprap by the Federal Bureau of Reclamation in Nevada. Paving of a section of Interstate Highway 15 near Sulphurdale resulted in an increase in sand and gravel production. Melvin Bradshaw, one of the four pumice producers in the State, mined pumice from a volcanic cinder deposit near Milford for use in manufacturing lightweight building block and other concrete products. A small quantity of quartz crystals and obsidian was collected by Orean Barney.

Box Elder.—The main reason for a 100-percent gain in mineral output value was the increased production of sand and gravel. The 1.8-million-ton production was 2½ times that of 1960. This output made the county the second largest producer of sand and gravel and one of five counties to exceed 1 million tons. About 500,000 tons of gravel was used as dam-embankment fill in the second stage of the Willard dam project. Slightly over 1 million tons was used in constructing sections of Interstate Highways 15 and 80 N. Building construction accounted for most of the balance. Leading producers of sand and gravel were Geo. M. Brewster & Sons, Inc., W. W. Clyde Co., Leslie Hawks, Thorn Construction Co., and Fife Construction Co. Lime was produced by Utah-Idaho Sugar Co., and salt was produced by Lake Crystal Salt Co.

Valley View Mining Co. mined gold, silver, lead, and zinc from the Tecoma mine. R. L. Casey & A. L. Pierce mined silver and lead from the Silver Belle mine.

Cache.—Output of 250,000 tons of sand and gravel by six commercial and two Government-and-contractor operations represented 58 percent of the total mineral value for the county. Limestone, mined by Legrand Johnson Corp. at The Amalgamated Sugar Co. quarry near Providence, was shipped to plants of The Amalgamated Sugar Co. for manufacturing lime used in refining sugar.

Carbon.—Carbon County, the leading coal producer, contributed 76 percent of all coal produced. The value of the coal, from 23 mines, accounted for 94 percent of the county and 6 percent of the State total value of mineral output. Fifty-eight percent (2.3 million tons) of the coal was mechanically cut, and all the coal was mechanically loaded by 85 mobile loading machines and 24 continuous mining machines. Seventy-four percent of the coal was mechanically cleaned: 2.8 million tons was cleaned by wet washing with jigs and other equipment, and 123,000 tons was cleaned by pneumatic methods. Of the total production, 1.5 million tons was treated with oil or other materials. Eleven mines produced more than 100,000 tons each and accounted for

87 percent of all coal produced: Carbon Fuel (Carbon Fuel Co.); Castle Gate No. 4, Kenilworth, and O'Connor No. 2 (Independent Coal & Coke Co.); Columbia and Geneva (Columbia-Geneva Steel Division, United States Steel Corp.); Spring Canyon No. 7 (Hileman & Ferderber Coal Co.); Sunnyside No. 1 and "B" Canyon, No. 2 and No. 3 (Kaiser Steel Corp.); and Wattis (Lion Coal Co.).

Natural gas from wells in the Clear Creek field contributed 6 percent of the county value of mineral output. Clear Creek field, which lies in Carbon and Emery Counties, produced 10 billion cubic feet or 17 percent of the natural gas in the State. Less than 1 percent of the county total value of mineral output was derived from producing gem stones, sand and gravel, and carbon dioxide.

Daggett.—Natural gas was produced from 10 wells in the Clay Basin field by Mountain Fuel Supply Co. and processed at its 22-million-cubic-foot-per-day refrigeration plant at Manila. Residual gas was marketed through company-owned pipelines to consumers in the Salt Lake City area. Liquid petroleum gases (debutanized natural gasoline) was used as a blending stock at refineries in Salt Lake City.

Davis.—Except for minor values of stone and gem stones, the entire mineral output value came from the production of construction sand and gravel by Dayton & Miller Red E Mix Concrete, Foss Lewis Sand & Gravel, Inc., and White Hill Sand & Gravel for use in building, paving, and fill.

Duchesne.—Petroleum production from the Duchesne field was 58 percent below that of 1960. No development was done during the year. No production of gilsonite was reported at the Parriette mine by Standard Gilsonite Co.

Emery.—Production from 12 underground mines totaled 1.1 million tons of bituminous coal valued at $6.4 million. Emery County was ranked as the second largest coal producer in the State. Virtually all the coal was mechanically loaded by mobile and continuous loading machines; 28 cutting machines were used. Of the total output, 702,000 tons was mechanically cleaned with jigs and other wet methods, and 863,000 tons was cut by machine. Coal accounted for 74 percent of the total value of mineral output. Thirty-seven percent of the output of bituminous coal was used in manufacturing coke for Utah steel plants. Leading producers were Columbia-Geneva Steel Division, United States Steel Corp., at the Geneva mine, and United States Fuel Co. at the King mine in Carbon and Emery Counties.

Emery County also was ranked as the second largest producer of uranium ore; 33 mines produced 89,000 tons (8 percent) of the State total output. Major producers were Four Corners Oil & Mineral Co., Shattuck Denn Mining Corp., Union Carbide Nuclear Co., and Central Oil & Mining Co. The ore was shipped to processing plants in Utah and Colorado. Vanadium contained in ores from the *Temple Mountain* district was recovered at uranium ore processing mills in Colorado.

Gravel produced by construction and maintenance crews of the Utah State Road Commission and the Emery County Highway Department accounted for 240,000 tons of the 1.1 million tons produced. W. W. Clyde Co. produced 879,000 tons, or 79 percent of the total output.

Natural gas production from three wells in the Flat Canyon field was marketed through pipelines.

Garfield.—Sand and gravel and stone made up 64 percent of the mineral output value. The National Park Service and Federal Bureau of Public Roads used 79,200 tons of gravel for paving; the Federal Bureau of Reclamation used 4,739 tons of stone for riprap for bank protection. The county was again second in the value of gem materials collected, principally agate and petrified wood.

Quantity and value of uranium ore production, from 39 operations, was less than in 1960. The grade of the ore mined declined from 0.92 percent U_3O_8 in 1960 to 0.67 percent, thus accounting for much of the drop in value. Individual mine production was relatively small; the grade of ore ranged from 0.10 to 2.19 percent U_3O_8.

The ores were processed at mills in Colorado where vanadium, a constituent of many of the uranium ores, was recovered.

Grand.—Petroleum production from six fields increased more than threefold over 1960 production from four fields. The Salt Wash one-well field, discovered in April, was the major producing field, followed by the Big Flat field. Natural gas production from the Bar X and Westwater fields increased nearly twofold over that of 1960. Development drilling resulted in production from two oil wells and eight gas wells. Uranium ore output, from 59 operations, declined 26 percent below 1960 production, which was from 45 operations. The grade of ore produced was 0.26 percent U_3O_8, the same as that for 1960. Major producers were Union Carbide Nuclear Co.; Thornburg Mining Co.; Climax Uranium Co., Climax Division, American Metal Climax, Inc.; and Utah Alloy Ores Co. Vanadium was recovered from uranium ores that contained significant quantities of vanadium oxide; these ores were processed at mills in Colorado. Uranium Reduction Co. operated its 1,500-ton-a-day uranium processing plant at Moab throughout the year.

Construction of the $30 million potash project of Texas Gulf Sulfur Co. near Moab began on February 23 with the initial blast to make room for the shaft collar and headframe. By yearend, 15 percent of the overall construction was completed. The planned mine and mill were expected to produce muriate of potash at about 3,000 tons per day when in full operation.

Iron.—Iron ore was the most important mineral commodity produced, accounting for more than 98 percent of total mineral output. Shipments of iron ore from six mines west of Cedar City constituted the entire output of iron ore in Utah in 1961. The leading producer, Columbia Iron Mining Co., shipped hematite and magnetite ores from the Desert Mound and Iron Mountain mines. Utah Construction & Mining Co. mined hematite ore at the Iron Springs mine near Cedar City; the output was contracted for by Columbia-Geneva Steel. Utah Construction & Mining Co. continued its contract-mining operations in the *Cedar City* district at the Blowout, Comstock, and Duncan mines owned by CF&I.

Coal produced by Koal Kreek Coal Co., Tucker Coal Co., and Webster Coal Co. from the Jones-Bulloch, Tucker, and Webster mines accounted for 1 percent of the total value of mineral production. All the coal produced was mechanically cut and loaded; all was sold on the open market. Two percent of the coal was treated with oil.

Juab.—Nonmetals constituted 66 percent of the value of mineral output. Halloysite (kaolin), mined by Filtrol Corp. at the Dragon mine, was the leading mineral in both quantity and value. The value of gem materials collected was $21,500, more than twice the value of gem stones collected in any other county. All the barite and fluorspar produced in the State came from Juab County. D.J. Garrick mined barite at a property near Trout Creek. Three operators—Chesley & Black, Willden Brothers, and United Technical Industries, Inc.—produced metallurgical-grade fluorspar at properties near Delta.

Uranium ore was second in mineral output value. Production from the Yellow Chief mine, operated by Topaz Uranium Co., increased significantly over that of 1960. Gold, silver, copper, lead, and zinc were recovered from lead and lead-zinc ores mined at Eureka.

Kane.—Gem material, consisting of agate and petrified wood, was the only mineral commodity produced.

Millard.—Nonmetals—pumice, sand and gravel, stone, and gem stones, in order of output value—accounted for 92 percent of the value of mineral production. Pumice, used as lightweight aggregate in concrete and in manufacturing building block, was produced by Central Block Co., Christensen Construction Co., and Ralph Memmott, from volcanic-cinder and scoria deposits near Fillmore. The Utah State Department of Highways used 23,000 tons of gravel for paving. Limestone was produced by George H. Chaffin from Leamington quarry and shipped to the West Jordan plant of the Utah-Idaho Sugar Co. for manufacturing lime for sugar refining. The value of collected gem materials (largely obsidian) was $7,765, an increase of about $3,000 over that of 1960. Small quantities of silver, lead, and zinc were produced from zinc ores at the Blue Bell dump in the *Gordon* (*Dry Valley Mountain*) mining district.

Morgan.—Mineral production was limited to three construction materials, cement, sand and gravel, and stone. Ideal Cement Co. operated at capacity its Devil's Slide quarry and cement plant, producing portland and masonry cements; masonry cement represented about 1 percent of the total cement sales. Portland cement for the Flaming Gorge dam was supplied from the Devil's Slide plant. Power consumption at the plant was about 41 million kilowatt hours for the year. Dismantling and scrapping of the old original Devil's Slide plant No. 1 began.

The production of 1.8 million tons of sand and gravel, a sevenfold increase over that of 1960, placed the county third in output of this mineral commodity. New road construction was the cause for the increase. W. W. Clyde Co. produced 84 percent of the output. Sand and gravel also was produced by Delbert Robinson, Edna Spackman, and Wilkson Construction Co.

Piute.—The major part of the mineral output value was uranium ore, produced at five operations by Vanadium Corporation of America and at two operations by D. L. Atherly & Sons. The ore was processed at the Salt Lake City plant of Vitro Chemical Co.

Arundel Mining Co. at Deer Trail mine, Warren Outzen at Bully Boy mine, and M. A. Linder at Shamrock mine produced gold, silver, copper, lead, and zinc.

Rich.—Phosphate rock and sand and gravel made up all the value of mineral output. The quantity of phosphate rock, all produced at Cherokee mine, near Randolph, by San Francisco Chemical Co. and shipped to the company plant at Sage, Wyo., for processing, was less than that of 1960. Sand and gravel production dropped from 87,600 tons in 1960 to 17,900 tons because of a large reduction in road construction.

Salt Lake.—Copper production by the Utah Copper Division of Kennecott Copper Corp. at the Utah Copper open-pit mine placed the county first in the State and the State second in the Nation in copper output. According to the company annual report, 27.8 million tons of ore containing 16.2 pounds of copper per ton was mined during the year. This was slightly less than the 28.1 million tons of ore mined in 1960. Output of copper was approximately 211,000 tons, compared with 215,000 tons in 1960.

Much of the gold and silver and all the molybdenum produced in the county were recovered from treating copper ores.

The U. S. and Lark mine, operated by United States Smelting Refining and Mining Co., was the largest producer of lead and zinc in the State and ranked second to Kennecott Copper Corp. in the production of gold, silver, and copper. Lead-zinc ore from the mine was treated in the company flotation mill at Midvale. The lead-zinc concentrate was shipped to the lead smelter at Tooele, and the zinc concentrate was shipped to Anaconda zinc plants in Montana. Copper, gold, and silver as well as lead and zinc were recovered from each of the concentrates shipped. In addition to lead-zinc ore, the company produced some gold-silver ore, which was shipped to the Tooele lead smelter.

Zinc—together with some lead, silver, and copper—was recovered from old slag from the Murray smelter dump; some of the slag was treated in the lead smelter and some in the zinc-fuming plant of International Smelting and Refining Co. at Tooele.

Four oil refineries in the Salt Lake City area were operated throughout the year. Throughput was 31.6 million barrels of crude petroleum, a 1-percent increase over that of 1960. At its Woods Cross refinery, Phillips Petroleum Co. began constructing an alkylation unit to be completed by mid-1962. Frontier Refining Co. announced a $2.5 million modernization program at its Beeline refining plant at North Salt Lake. Plans included a catalytic cracking unit, but the capacity of 6,000 barrels per day would not be increased.

Vitro Chemical Co. operated its 600-ton-per-day uranium processing plant at Salt Lake City. The company and AEC were negotiating a contract for purchasing uranium oxide concentrate for the 1962–66 period. This contract was to replace the original contract that was to terminate on March 31, 1962.

Vanadium oxide recovered from slags from elemental phosphorus furnaces in Idaho by Susquehanna Minerals at the remodeled Calera cobalt refinery at Garfield was credited to the mineral production of Idaho. Operations at the plant began in August and were continued throughout the year.

Cement, sand and gravel, and salt each had a production value in excess of $1 million. Cement, the leading nonmetal commodity, was produced by Portland Cement Co. of Utah at its Salt Lake City plant. Cement sales, two-thirds greater than those in 1960, were increased by doubling the plant capacity at a cost of $2.5 million.

Production of 4 million tons made Salt Lake County the leading sand and gravel county. The Utah State Road Commission (District No. 2), the largest consumer, used 2.3 million tons of sand and gravel for road construction. Utah Sand and Gravel Products Corp. was the major commercial producer. Other commercial operators who produced over 100,000 tons during the year were Harper-Jackson Sand & Gravel Co. and South East Sand & Gravel.

Morton Salt Co., operating near Saltair, was the leading salt producer of the State. Lime was produced by Kennecott Copper Corp. at Garfield for processing copper ores and by Utah-Idaho Sugar Co. at Salt Lake City for refining sugar.

San Juan.—San Juan County led in producing petroleum, natural gas from oil wells, natural gas liquids recovered at processing plants, and uranium ore. The county contributed 26 percent of the total value of all mineral production in the State, 83 percent of the petroleum, 84 percent of the oil well gas, and 87 percent of the uranium ore.

Petroleum was produced from 598 wells in 13 established fields and from 9 undesignated fields discovered in 1961. A 14-percent decrease in output was the result of unit operations and the establishment of water-flood and repressuring programs in the Greater Aneth area conducted to insure the maximum recovery of oil from the reservoirs. Production of oil well gas was closely regulated to maintain pool pressures until secondary-recovery programs became fully operative. Four units—Aneth, McElmo Creek, Ratherford, and White Mesa—were to be involved initially in the water-flood program, with the Aneth and McElmo Creek units the first to start. Development drilling resulted in 56 oil wells and 2 gas wells. One of the oil wells in the Lisbon field was a dual completion. Major development drilling was conducted in the Greater Aneth area at the Aneth, Ismay, McElmo Creek, and Ratherford units. The discovery of the Anida field near the Arizona State line, south and west of the Greater Aneth area, was of considerable importance. Initial production was in excess of 2,000 barrels of oil a day; however, at wells completed later, the initial production rates were less than 500 barrels a day.

Oil well gas, mostly from the Greater Aneth area, was processed at the El Paso Natural Gas Co. 100-million-cubic-foot-a-day plant at Blanding. Throughput, averaging 85 million cubic feet a day, approached design capacity near the end of the year. Residual gas from the plant was marketed through the El Paso Natural Gas Co. pipeline to consumers in southern California. Natural gas liquids (butane, propane, and natural gasoline) were transported by pipeline to the Wingate fractionation plant near Gallup, N. Mex., and thence to the Ciniza refinery 10 miles to the east for use as a blending stock.

Uranium ore was produced at 163 operations and although the quantity of ore produced increased slightly, the quantity of contained uranium oxide declined. The average grade of ore mined was 0.29 percent U_3O_8 compared with 0.31 percent in 1960. Hecla Mining Co., The Hidden Splendor Mining Co., Standard Metals Corp., Texas-

Zinc Minerals Corp., and Utex Exploration Co., were among the 10 operators who produced in excess of 10,000 tons each. Vanadium in significant quantities occurred in some uranium ores produced and was recovered at uranium processing mills in Colorado that had vanadium-recovery units. Concentrates containing copper and small quantities of silver, lead, and zinc were recovered from some uranium ores and were processed at the 1,000-ton-per-day mill at Mexican Hat by Texas-Zinc Minerals Corp.

Sanpete.—Value of sand and gravel production accounted for 65 percent of the mineral value. A contractor for the Utah State Road Commission, Cox Bros., and Hales Sand & Gravel Co. produced sand and gravel for building, paving, fill, and miscellaneous uses. Morton Salt Co. mined rock salt from a mine near Redmond. Azome Utah Mining Co. produced a small tonnage of clay at its Azomite clay pit for a poultry-feed supplement.

Natural gas production, from the 2-well Joe's Valley field, was 90 percent less than in 1960; intermittent operation of the field caused the reduced output. Delhi-Taylor Oil Corp. purchased Three States Natural Gas Co. on June 1 and operated the field thereafter.

Sevier.—Production of gypsum, the leading mineral commodity, by Bestwall Gypsum Co. and United States Gypsum Co. was less than 1 percent below that for 1960. Besides operating their own mines, these two companies operated wallboard manufacturing plants at Sigurd. Southern Utah Fuel Co. operated the No. 1 mine; coal output was 4 percent below that of 1960. Bentonite, mined by Western Clay & Metals Co. at its Aurora pit and by Macco Corp. at its Bosshardt pit, was used in manufacturing refractories, in rotary-drilling mud, and for miscellaneous uses. Fuller's earth, produced by Western Clay & Metals Co. at its Redmond pit, was used for filtering mineral oils and greases. Hales Sand & Gravel Co. and a contractor for the Utah State Road Commission produced sand and gravel for building, paving, and fill. At its mine near Redmond, Poulson Brothers Salt Co. mined rock salt for stock feed. Wonderstone, collected by Johnny's Rock Shop, was the only gem material output reported.

Summit.—Of the total mineral output value, nonmetals contributed 64 percent, metals contributed 31 percent, and fuels contributed 5 percent. The 1.5-million-ton output of sand and gravel placed the county fourth. W. W. Clyde Co., the major producer, used the material in new road construction. Wortley Co. produced a small quantity of sand. Subcontractors for the Federal Bureau of Reclamation quarried sandstone and quartzite for riprap on the Provo River project. Heavy clay products were manufactured from clay mined by Gladding, McBean & Co. and Interstate Brick Co.

Lead-zinc and silver ores were mined by United Park City Mines Co. at its mines, and lead-zinc ore was mined by United Park City Mines Co. and Keystone Mining Co. in a joint venture at the Keystone mine. McFarland & Hullinger, lessees, produced gold-, silver-, and copper-bearing smelter fluxing material from the Daly mine dump of United Park City Mines Co. Silver-bearing fluxing material, with minor quantities of gold and copper, also was produced from the Ontario and Quincy mine dumps by McFarland & Hullinger and G. Wm. Wortley, respectively.

Coal output, all produced by Chappel Coal Co., was slightly below that of 1960.

Tooele.—Nonmetals collectively accounted for 91 percent of the total mineral production value. Three nonmetals—lime, potassium salts, and salt—made up 79 percent of the total. The Utah Lime & Stone Co. crushed limestone at its quarry and produced quicklime and hydrated lime at its processing plant near Grantsville. The lime was used in refractory construction, chemical, and other industries. Crushed limestone was sold for use as flux, cement ingredient, refractory and filler materials, and rock dust for coal mines. Utah Marblehead Lime Co. produced dead-burned dolomite from rock quarried near Tooele.

Bonneville, Ltd., reported a 14-percent increase in sales of potassium salts from its evaporation plant near Wendover. Capacity of the operation was enlarged by digging additional ditches and increasing the brine-pumping rates. Construction of a compacting plant to produce granular potash products, which was started late in the year, was to be completed in April 1962.

Leslie Salt Co. at Tooele, Solar Salt Co. at Grantsville, and Utah Salt Co. at Wendover produced 10 percent more salt by solar evaporation than in 1960. A 2-foot drop in the level of Great Salt Lake was overcome by deepening and lengthening ditches.

The total output of sand and gravel, all by England Construction, Inc., was used in building construction, paving, and fill.

International Smelting and Refining Co. produced limesand at the Stansbury Island operation for use as flux in its lead smelter at Tooele. Utah Calcium Co. produced poultry grit and roofing granules at its Aragonite quarry. Gladding, McBean & Co. and Interstate Brick Co. mined clay for manufacturing heavy clay products.

A large increase in metals output value was caused by production of lead, zinc, silver, copper, and gold by McFarland & Hullinger, lessees of the reopened Ophir mine of United States Smelting Refining and Mining Co. and by Art Amodt and V. E. Peck, lessees of the Mecca Mining Co. The Tooele smelter of International Smelting and Refining Co. was operated throughout the year without interruption, but on a curtailed basis.

Uintah.—Petroleum production, from 190 wells in 4 fields, was 3 percent below that of 1960. Extensive exploratory drilling resulted in 13 gas wells classified as new discoveries by the State Oil and Gas Conservation Commission. One well, Unit No. 1 in the Rainbow Unit, was a dual completion with potential production from the Wasatch and Mesaverde formations. Another well, Unit No. 4 in the Ute Trail Unit, was reworked and deepened with a potential production from the Wasatch formation. All gas discoveries were shut in, pending connections to gathering lines. Development drilling was done largely in the Red Wash field where 25 new producing oil wells were completed, and in the Chapita Wells gasfield where 12 new producing wells were completed. Five new gas wells were completed in the Rock House field; Unit No. 3 was a dual completion with potential production from the Wasatch and Mesaverde formations. Other development drilling resulted in new gas wells in Southman Canyon, Stagecoach, Bitter Creek, and Island fields. In November, Mountain Fuel Supply Co. and Utah Natural Gas Co. (El Paso Natural Gas Co.) completed a 20-inch, 103-mile natural gas transmission line from Uintah County gasfields through Duchesne and Carbon Counties to connect with the Utah Natural Gas Co. line at the Clear Creek field. The pipeline had an initial capacity of 100 million cubic feet of gas a day, which could be increased to 200 million cubic feet by adding compressor stations. Concurrently, with construction of the transmission line, gathering lines were being built to individual fields and wells. Mountain Fuel Supply Co. acquired gas reserves in the Ute Trail and Uintah fields from the U.S. Oil Division, DeKalb Agricultural Association, Inc., and DeKalb Petroleum Corp.

California Oil Co. completed a new natural gas plant to process oil well gas at the Red Wash field. The refrigeration plant, designed to process 38 million cubic feet a day, was operated at a daily rate of 26 million cubic feet. Approximately 275 barrels of natural gasoline was recovered daily and transported at intervals with crude oil from the field to refineries at Salt Lake City. Residual gas (11.25 million cubic feet daily) was sold to El Paso Natural Gas Co. for distribution.

American Gilsonite Co. operated its Bonanza mine, and G. S. Ziegler & Co. and contractors operated the Little Bonanza, Little Emma, and Warner-Quinlan mines. Production from the Bonanza mine was transported through a 72-mile pipeline to the company-owned plant near Fruita, Colo., where gasoline, diesel fuel, and metallurgical coke were recovered.

San Francisco Chemical Co. completed the first full year of operation at its phosphorite deposit and 50-ton-per-hour concentrator near Vernal. Concentrates were shipped to the Garfield fertilizer plant of Western Phosphates, Inc., for treatment. Initial investment for the mining operation and concentrator was $5 million. The company announced plans to construct five more plants on 27 square miles of phosphorite-bearing private property it had purchased.

The fourfold rise in sand and gravel production over that of 1960 resulted from increased road construction. The Federal Bureau of Reclamation used 17,000 tons of limestone as riprap.

Utah.—Nonmetals constituted 99 percent of the value of mineral output. Utah County was the leading stone producer. Limestone was mined and crushed at the Keigley quarry by Columbia-Geneva Steel for flux in making iron, refractory material, concrete and roadstone, and railroad ballast. Lakeside Lime & Stone Co. produced limestone for manufacturing lime and for coal-mine dust.

Clay output increased slightly over that of 1960. R. D. Wadley Clay Co. (Wadley pit), Loyd R. Stubbs (North claim), Western Fire Clay Co. (Fawn mine), Gladding, McBean & Co. (Clinton mine), Interstate Brick Co. (Powell pit), and United Brick Co. (No. 24 pit) produced clay for making refractories and heavy clay products.

Total production by 10 commercial and 1 Government-and-contractor sand and gravel operations was 343,000 tons. The principal producers were Geneva Rock Products, Inc., Hurst Ready Mix, Inc., and Whiting & Haymond Construction.

Onyx, variscite, and other gem materials collected were valued at $2,500.

Columbia-Geneva Steel Division continued investigating the use of oxygen as a means of increasing production from open-hearth furnaces at the Geneva works. Three of the four furnaces equipped with oxygen feeders utilized oxygen. About 45 tons of oxygen used in the feeders was supplied from the company nitrogen plant; the remainder was purchased. Growing importance of western steel was highlighted at Geneva on March 8 when Columbia-Geneva Steel Division established the Raw Materials Research Laboratory. Reported to be one of the most advanced research centers in the Nation's steel industry, the laboratory was used exclusively in studying raw materials for steelmaking.

Wasatch.—The value of mineral production, more than double that of 1960, resulted from a sharp increase in metals output. The combined value of lead and zinc was $4 million, accounting for 77 percent of the county mineral production value. The increased output of gold, silver, copper, lead, and zinc was due primarily to a greater production from the Wasatch County part of the United Park City Mines Co. mines (92 percent of the company total production was mined in Wasatch County compared with 2 percent in 1960). The United Park City Mines Co. mines ranked second in the State to U.S. and Lark mine in output value of lead and zinc. In December, Hecla Mining Co. assumed operation of the Mayflower Unit of New Park Mining Co. Before this change, production of gold, silver, copper, lead, and zinc was made by a lease operation at the unit.

Washington.—Gravel was the leading commodity in mineral output value; no production of sand was reported. Four contractors—L. G. Stevenson Construction Co., V. C. Mendenhall, Stout Construction Co., and Strong Co.—produced 190,000 tons of gravel for road construction by the Utah State Road Commission.

Emerald L. Cox shipped copper ore from the Apex mine in the *Tutsagubet* mining district to the Asarco El Paso (Tex.) copper smelter. The ore, which contained small quantities of silver, lead, and zinc, was valued at $46,566.

Petroleum production from the 6-well Virgin field was 50 percent below that of 1960. All wells were shut in by yearend.

Wayne.—Whiting & Haymond Construction, a contractor for the Federal Bureau of Public Roads, produced 16,200 tons of limestone for protecting road banks.

Most of the uranium ore, produced at four mines, was processed by Vitro Chemical Co. at its plant in Salt Lake City. A small tonnage of ore was shipped to the Green River upgrading plant before it was shut down in February. The major producer was McFarland & Hullinger at the Ibex mine. Recovery of vanadium from ore shipped to the Green River plant was made at the mill at Rifle, Colo.

Weber.—The value of approximately 500,000 tons of sand and gravel represented the major part of the total mineral production value. Commercial and Government-and-contractor output of the materials was about equal. Holley Co., Miya Bros., and Douglas B. Stephens Co. were commercial operators. The Federal Bureau of Reclamation used 28,500 tons of crushed stone in road construction. Miscellaneous clay, mined by Harrisville Brick Co. (subsidiary of Gladding, McBean & Co.), was used for manufacturing building brick.

The Mineral Industry of Vermont

By James R. Kerr[1]

◆

THE VALUE of Vermont's mineral production in 1961 increased 6 percent owing to greater value of sand and gravel and stone output. Most of the increased valuation was attributed to increased roadbuilding, which called for large quantities of aggregate material. However, value of dimension marble, granite, and slate output comprised 70 percent of total stone value.

Rutland County with its valuable marble and slate deposits led in value of mineral production. Washington and Orleans Counties followed, with granite and asbestos their leading minerals, respectively.

TABLE 1.—Mineral production in Vermont[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	(²)	$1	(²)	$2
Sand and gravel short tons	1,809,152	1,218	2,232,266	1,567
Stone do	2,114,377	17,444	2,731,418	18,715
Value of items that cannot be disclosed: Asbestos, clays, lime, and talc		4,240		4,012
Total Vermont[3]		22,879		24,283

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Weight not recorded.
[3] Total value adjusted to eliminate duplicating value of stone.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—Chrysotile asbestos was mined in Orleans County at a slightly increased rate. Shipments, which were of 25 different grades, ranged in price from $28 to $400 per ton. The average price per ton decreased to $85.34, compared with $90.91 in 1960.

Clays.—Kaolin was mined for the first time in recent years with the opening of a pit at Monkton in Addison County. Miscellaneous clay production for building brick was less than in 1960.

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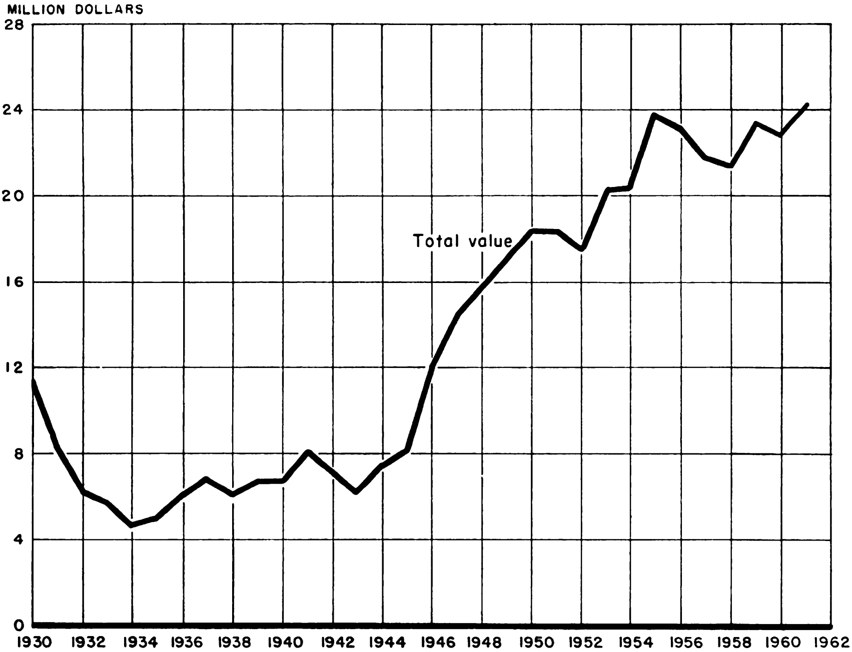

FIGURE 1.—Total value of mineral production in Vermont, 1930–61.

Gem Stones.—Specimens of actinolite (an asbestos mineral), talc, magnetite, garnet, and other minerals were collected by hobbyists and gem dealers throughout the State.

Lime.—Reduced production of both quicklime and hydrated lime was reported. Quicklime was sold for chemical uses; the hydrated lime was sold for construction.

Mica, Reconstituted.—Specially delaminated mica scrap was used by Samica Corp. (subsidiary of Minnesota Mining & Manufacturing Co.) to produce reconstituted mica at Rutland.

Sand and Gravel.—Production of commercial sand and gravel increased 2 percent. The average price per ton increased $0.04, to $1.09, as the percentage of total output processed increased 6 percent, to 85 percent. Output of gravel, chiefly for paving, increased to 66 percent of total production compared with 52 percent in 1960. The sharp increase in paving gravel output resulted from increased roadbuilding activity. Output of paving sand decreased. Production was reported from 32 operations throughout the State.

Government-and-contractor output of sand and gravel increased 44 percent. Greatest activity was in Windham County. Significant tonnages also were produced in Essex, Bennington, Windsor, Orleans, and Chittenden Counties. Government-and-contractor operations (chiefly the Vermont State Highway Department) are not listed in the county review section but are summarized in table 2.

Stone.—Production of stone increased 29 percent owing to the large output of crushed sandstone by the Vermont State Highway Depart-

TABLE 2.—Sand and gravel production by Government-and-contractor operations, by counties

(Short tons)

County	1960	1961	County	1960	1961
Addison	76,222	16,913	Orange	5,800	6,000
Bennington	38,574	119,973	Orleans	2,900	117,198
Calendonia	12,406	13,500	Rutland	64,765	9,000
Chittenden	229,194	105,953	Washington	145,096	53,787
Essex	37,519	183,938	Windham	57,763	417,215
Franklin	11,284	49,892	Windsor	76,017	118,889
Grand Isle	63,497	3,000	Unspecified	79,911	59,108
Lamoille	7,250	38,061			
			Total	908,198	1,312,427

ment for road construction in Windham County. Production of crushed limestone, which was used chiefly for road base material, increased 8 percent. However, output of crushed granite and miscellaneous stone decreased. Output of dimension granite and dimension marble, high unit-priced stone products, increased slightly. Less dimension granite was produced for rough architectural work, but some granite output was reported in 1961 for dressed architectural stone. The quantities of dimension marble for most uses remained about the same as in 1960, but the quantity used for rough building exterior increased significantly. Slate production decreased slightly but a 26-percent increase in price for structural slate resulted in a slight increase in overall slate value.

REVIEW BY COUNTIES

Addison.—Vermont Associated Lime Industry's New Haven limestone quarry was idle in 1961. However, a small tonnage of quicklime shipped from the company's Winooski plant in Chittenden County was hydrated at New Haven. Vermont Kaolin Corp. began operations at Monkton, producing a small tonnage of kaolin. Paving gravel was produced at scattered locations.

Bennington.—Burgess Brothers produced sand and gravel at a portable plant near Bennington.

Caledonia.—Paving sand and gravel was produced at a portable plant near St. Johnsbury by Caledonia Sand & Gravel Co., Inc.

Chittenden.—L. A. Demers Crushed Rock Co. produced crushed limestone and the Vermont State Highway Department produced over 600,000 tons of crushed limestone for construction of U.S. Route 2 from Montpelier to Burlington. Rowe Contracting Co. did not operate in 1961. Vermont Associated Lime Industries, Inc., produced crushed limestone for agstone and lime manufacture at a quarry near Winooski. The company continued a modernization program, which included a continuous lime hydrating unit.

Sand and gravel was produced at four operations near Burlington. W. C. Kirby, contractor, was the leading producer. Vermont Paving Corp. purchased the Cass-Warner gravel pit and produced bank run gravel for building and paving.

Drury Brick Co. mined miscellaneous clay for building brick at a plant near Essex Junction. The company sold the plant to Dinsmore Brick Co., Lebanon, N.H.

TABLE 3.—Value of mineral production in Vermont, by counties

County	1960	1961	Minerals produced in 1961 in order of value
Addison	(1)	(1)	Sand and gravel, clays, lime.
Bennington	(1)	(1)	Sand and gravel.
Caledonia	(1)	(1)	Do.
Chittenden	$1,372,177	$1,761,993	Stone, lime, sand and gravel, clays.
Essex	51,471	(1)	Sand and gravel.
Franklin	(1)	(1)	Stone, sand and gravel.
Grand Isle	(1)	1,600	Sand and gravel.
Lamoille	(1)	(1)	Talc, sand and gravel.
Orange	(1)	(1)	Stone, sand and gravel.
Orleans	(1)	(1)	Asbestos, sand and gravel, stone.
Rutland	9,746,755	9,990,820	Stone, sand and gravel, clays.
Washington	(1)	(1)	Stone, sand and gravel.
Windham	264,608	1,312,579	Stone, sand and gravel, talc.
Windsor	392,942	520,145	Do.
Undistributed [2]	11,051,918	10,695,693	
Total	22,879,000	24,283,000	

[1] Figure withheld to avoid disclosing individual company confidential data included with undistributed.
[2] Includes gem stones and some sand and gravel that cannot be assigned to specific counties, and values indicated by footnote 1.

Essex.—Paving sand and gravel was produced by A. Booska at a stationary plant.

Franklin.—Swanton Lime Works, Inc., produced crushed limestone at Swanton for roadstone, agstone, paper manufacturing, mineral food, and terrazzo. S. H. Evanson operated a stationary plant near Swanton producing chiefly building sand, as well as a small tonnage of engine sand, paving sand, and building gravel. Ray Dubois produced sand for use on icy roads.

Grand Isle.—Vermont Marble Co. did not operate its La Motte quarry in 1961.

Lamoille.—Eastern Magnesia Talc Co., Inc., operated its Johnson No. 4 mine producing crude talc chiefly for grinding at the company mill. Ground output was sold for roofing, paper, rubber, paint, insecticides, and other uses. A small tonnage of crude talc was shipped to a foundry in Cleveland, Ohio. Albert Nadeau produced paving sand and gravel at a portable plant near Johnson, and Kenneth Farr sold bank run gravel for a variety of uses.

Orange.—Rock of Ages Corp., Pirie Division, quarried dimension granite near Williamstown for rough monumental stone. Willard B. Martin produced bank run paving gravel near Bethel, and Levi Lemieux produced building and paving gravel at a stationary plant near Barre Town.

Orleans.—Vermont Asbestos Mines, Division of the Ruberoid Co., mined and processed chrysotile asbestos at the Lowell quarry and mill, producing 25 grades of asbestos. Prices varied dependent upon length or quality of fiber or other controlling feature. This company also produced miscellaneous stone for fill at the same location. H. C. Calkins produced paving sand and gravel at a stationary plant near Danville. Ralph B. Goodrich, Inc., produced bank run paving sand and gravel under contract for the Vermont State Department of Highways.

Rutland.—Vermont Marble Company operated five quarries and finishing plants and produced cut and sawed dressed building and monumental marble and rough building marble. Output was slightly higher than in 1960. The building marble was for both exterior and interior uses. Green Mountain Marble Co., Division of Georgia Marble Co., produced dimension marble, chiefly cut dressed monumental and cut dressed building varieties. The tonnage of dimension slate was slightly less than in 1960, but its value was greater. Uses for the product included structural and sanitary, flagging, roofing, and architectural. Leading producers were Vermont Structural Slate Co. (four quarries), Fair Haven Slate Co., Hilltop Slate Co., and John Hadeka. White Pigment Corp. quarried and crushed limestone to manufacture whiting for paint and rubber filler, flooring, plastics, and a wide variety of miscellaneous uses. Vermarco Lime Co. produced crushed limestone for roadstone and agstone at operations at West Rutland and Loveland.

Sand and gravel chiefly for paving was produced at five pits. Vermont Paving Corp., a new operator, processed its sand and gravel for an asphalt mix plant. Joseph Carrara and Carter Brothers were other leading producers. Rutland Fire Clay Co. produced a small tonnage of fire clay mortar from its miscellaneous clay stockpile.

Washington.—Dimension granite was quarried by Rock of Ages Corp. at the Graniteville, Wetmore and Morse, E. L. Smith, and Woodberry quarries. Output was chiefly rough monumental stone. Wells-Lamson Quarry Co., Inc., also quarried rough monumental granite at Websterville as well as crushed granite for roadstone. The Charles A. Pillette quarry was idle. County output was slightly greater than in 1960. Government-and-contractor output of crushed miscellaneous stone for roadstone was reported.

Sand and gravel was produced at four pits. Output was chiefly building and paving material. Leading producers were William E. Dailey, Jr., West Bennington and King's Pit, South Barre.

Windham.—The Vermont Highway Department produced over 800,000 tons of crushed sandstone for road construction. In addition over 400,000 tons of Government-and-contractor paving sand and gravel was produced, attesting to a greatly accelerated road building program in the county. Brattleboro Sand & Gravel Co. produced chiefly building sand and gravel at a stationary plant near Brattleboro.

Vermont Talc Co. mined talc near Windham for grinding at its mill at Chester, Windsor County. Chief uses for the ground talc were for insecticides, rubber, and paper manufacture.

Windsor.—Vermont Marble Co. quarried dimension marble at its Rochester Quarry. Also produced was a small tonnage of crushed marble for flagging, chips, and other uses. Barre Building Granite Corp. produced rough architectural building stone from a quarry near Bethel. The Vermont State Highway Department produced crushed limestone for roadstone. Eastern Magnesia Talc Co., Inc., mined talc near Reading for grinding at its Chester mill. Ground output was sold for roofing, rubber, paper, and other uses. Sand and gravel was produced by Sharon Sand & Gravel, in Sharon, and Martin Marietta Corp. in Windsor. Output was chiefly for building and paving.

The Mineral Industry of Virginia

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Virginia Division of Mineral Resources.

By Robert W. Metcalf,[1] James L. Calver,[2] and Victoria M. Dorchak[3]

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THE VALUE of Virginia's mineral output in 1961 rose 9 percent to $222 million, which was only slightly less than the high established in 1957. Bituminous coal, sand and gravel, zinc, stone, and kyanite established production records in both quantity and value. All of the construction materials registered gains in tonnage over 1960. Production of iron ore (pigment material), pyrites, salt, soapstone, and titanium concentrate were less than in 1960. Production of bituminous coal, the leading commodity, increased 9 percent in quantity and 3 percent in value. In quantity, the output was 2 percent higher than the former high of 1959; however, the value was 9 percent less. Output of lead increased nearly 75 percent, and that of zinc rose nearly 50 percent over 1960. The chief minerals in order of value of production were coal, stone, portland cement, sand and gravel, lime, and zinc. The value of fuels comprised 57 percent of the total value of mineral production in the State (60 percent in 1960 and 63 percent in 1959). The value of nonmetals was 39 percent of the total, and that of metals was 4 percent.

A fourth bulletin in a series on mineral localities in Virginia was published. This pamphlet listed several minerals and varieties for the first time and noted nearly 200 additional mineral localities. A checklist of Virginia minerals also was included.[4] A layman's guide to mineral and rock collecting in Virginia was issued by the Virginia Division of Mineral Resources. Physical properties of minerals, occurrences of the more common minerals, and description and distribution of the different rock types in Virginia were outlined.[5]

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[2] State geologist, Virginia Division of Mineral Resources, Charlottesville, Va.

[3] Statistical clerk, Bureau of Mines, Pittsburgh, Pa.

[4] Dietrich, R. B. Virginia Mineral Localities, Supp. 1. Virginia Polytechnical Inst. Eng. Exp. Sta. Ser. No. 143, Blacksburg, Va., 1961, 31 pp.

[5] Batcke, G. B. Identification Guide to Common Minerals and Rocks of Virginia. Division of Mineral Resources Inf. Circ. No. 3, Charlottesville, Va., 1961, 51 pp.

TABLE 1.—Mineral production in Virginia[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Aplite..........thousand long tons..	(2)	(2)	97	$651
Clays..........thousand short tons..	1,348	$1,395	1,406	1,332
Coal (bituminous)..........do....	27,838	122,723	30,332	126,121
Gem stones..........	(3)	5	(3)	6
Lead (recoverable content of ores, etc.).....short tons..	2,152	504	3,733	769
Lime..........thousand short tons..	711	8,028	739	8,596
Mica, sheet..........pounds..	103	1	(2)	(2)
Natural gas..........million cubic feet..	2,227	604	2,466	668
Petroleum (crude)..........thousand 42-gallon barrels..	2	(2)	[4] 6	(2)
Sand and gravel..........thousand short tons..	7,666	11,432	9,839	14,697
Stone..........do......	19,358	33,019	22,934	39,206
Zinc (recoverable content of ores, etc.)[5]....short tons..	19,885	5,142	29,163	6,726
Value of items that cannot be disclosed: Portland cement, masonry cement, feldspar, gypsum, iron ore (pigment material), kyanite, pyrites, salt, soapstone, titanium concentrate (ilmenite and rutile), and values indicated by footnote 2..........	....	[6] 26,027	....	27,757
Total Virginia[7]..........	....	[6] 203,887	....	221,835

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Weight not recorded.

[4] Preliminary figure.

[5] Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

[6] Revised figure.

[7] Total adjusted to eliminate duplicating value of clays and stone.

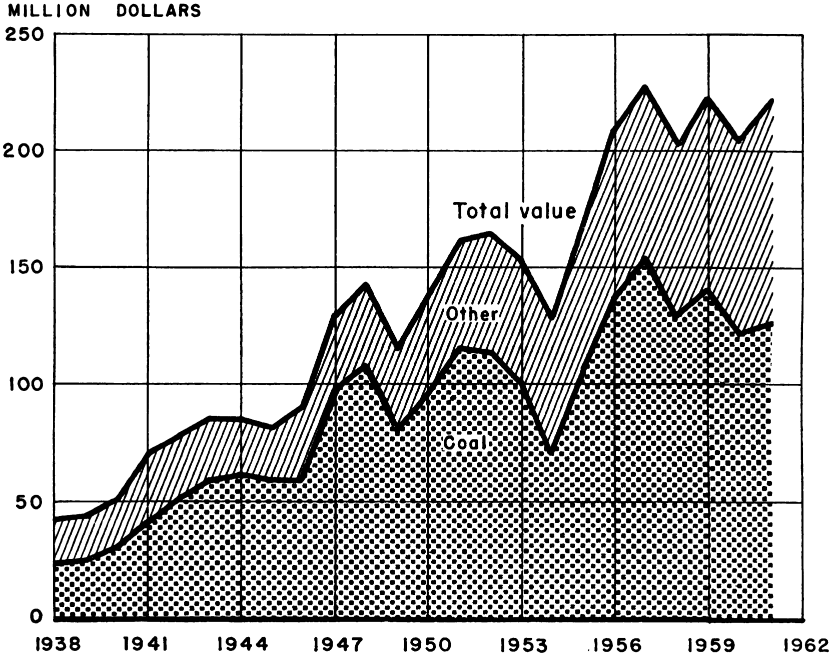

FIGURE 1.—Value of coal and total value of mineral production in Virginia, 1938–61.

Employment and Injuries.—Four fatalities were reported in the State's quarries and mills compared with none in 1960. Nonfatal injuries in quarries and mills, however, dropped markedly compared with 1960. Nonfatal injuries for metals and for sand and gravel increased sharply. Fatal accidents in coal mines totaled 30 compared with 24 in 1960.

TABLE 2.—Employment and injuries for selected mineral industries

Industry	Average number of men working	Total man-hours	Total number of lost-time injuries		Total number of injuries per million man-hours	
			Fatal	Nonfatal	Fatal	Nonfatal
1960:						
Coal mines	13,145	21,069,688	24	885	1.14	42.00
Metals [1]	463	784,417	---	25	---	31.87
Clay mines [2]	68	127,908	---	3	---	23.45
Nonmetal mines [3]	213	420,517	---	6	---	14.27
Quarries and mills [4]	3,605	7,501,834	---	234	---	31.19
Sand and gravel [5]	580	1,167,957	---	19	---	16.27
1961: [6]						
Coal mines	(7)	(7)	30	(7)	(7)	(7)
Metals [1]	392	789,417	---	48	---	60.80
Clay mines [2]	61	115,187	---	2	---	17.36
Nonmetal mines [3]	247	475,465	---	5	---	10.52
Quarries and mills [4]	3,650	7,890,723	4	160	.51	20.28
Sand and gravel [5]	731	1,593,371	---	28	---	17.57

[1] Includes mine and mill data and officeworkers.
[2] Excludes mill data and officeworkers.
[3] Excludes clay mines, also nonmetal millworkers and officeworkers.
[4] Includes cement and lime plants having no quarry operations; excludes officeworkers.
[5] Excludes officeworkers.
[6] Preliminary figures.
[7] Data not available.

Trends and Developments.—Among the outstanding developments in 1961 were a new coal mine expected to produce 1.2 million tons annually; a new underground gypsum mine; and doubling the capacity of the Norfolk & Western Railway Co. Lambert's Point coal pier at Norfolk. A new company, Minerals Development Corp., was formed for the exploration and possible development of iron ore deposits in iron-bearing sandstone in Giles and Bland Counties. This was a joint project of Norfolk & Western Railway Co., Roanoke Electric Steel Corp., and E. L. Keesling of Bramwell, W. Va. A number of prospecting permits were issued in the Jefferson National Forest in Giles and Bland Counties.

Of particular significance to the economy of the whole Norfolk and Hampton Roads area was the Chesapeake Bay Bridge-Tunnel, a 17½-mile $200 million crossing of Lower Chesapeake Bay from the tip of the Eastern Shore to a point near Norfolk. Features of this major undertaking included nearly 12 miles of low-level trestle over the bay; two trench-type tunnels under the main navigation channels (Baltimore Channel and Thimble Shoal Channel), each over a mile long; four manmade islands to support the tunnel ends, rising about 30 feet above mean low water; two high-level fixed steel bridges, one over the North Channel and the other over Fisherman inlet; and a 9,000-foot-long earth-filled causeway across Fisherman Island. This project would require over 500,000 tons of sand and gravel, and nearly 1.7 million tons of granite in sizes varying from three-quarters of an inch to 10 to 15 tons. This material was to be supplied principally from Virginia quarries by four companies. Part of the material, however, was to be obtained from North Carolina. All of the sand and gravel was to be supplied by Southern Materials Co., Inc., the prime contractor and part producer of the rock used in the project. Most of the rock used in the project was to be for the construction of four artificial islands. The prestressed cylindrical piles as well as the deck units were being built by Bay Shore Concrete Products Corp. at a $3.5 million casting yard at Cape Charles near the north end of the project. This plant combined sand from the Eastern Shore and sand and gravel from the Norfolk area in the manufacture of these products. Several articles were published describing this large and complicated project.[6]

Of particular interest to the Roanoke-Lynchburg-Danville area was the announcement of the pending construction of two dams along the Roanoke River: an Upper Dam across Smith Mountain Gap and a Lower Dam 17 miles downstream near Leesville. One of the chief features was the planned re-use of part of the water going through the Upper Dam's turbines into the lower lake by pumping it back into the Upper Dam's storage facilities.

Other developments in Virginia included the designing and building of a $22 million nuclear core for the Consolidated Edison Co., Indian Point, N.Y., nuclear installation. The active core for this project was built by Babock & Wilcox Co., Atomic Energy Division Laboratory at Lynchburg. This full-scale nuclear reactor core used a fuel mixture of thorium and uranium oxides and was successfully "taken critical" during the year. The core measures 6½ feet in diameter by 8 feet high and weighs more than 40 tons. The core consists of 120 fuel elements, 21 control rods, and associated internal hardware.[7]

Legislation and Government Programs.—Small quantities of mica were purchased from two operators, one in Amelia County and one in Henry County, for the national stockpile. Purchases by the Government were effected through the General Services Administration (GSA), Spruce Pine, N.C., and Franklin, N.H., Materials Purchase Depots.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Spurred by sharply increased output in Dickenson and Wise Counties, production rose to 30.3 million short tons—2 percent more than in 1959, the previous record year. Production data includes coal produced from deposits within Virginia, whether the mine opening is or is not inside the State boundary, and excludes operations producing less than 1,000 tons per year. Value of production, however, was 9 percent below the $139 million recorded in 1959. The average value per ton was 6 percent less than in 1960. The continuing fall of coal prices attested to a vigorous program of modernization and cost cutting at the State's mines. Both low- and high-volatile coals were produced for domestic and industrial purposes and for export. A small tonnage of semianthracite was mined for domestic heating. Coal was produced in eight southwestern counties; Buchanan, Dickenson, Wise, and Russell Counties accounted for 95 percent of the total. Of total production, 93 percent came from underground mines, 5 percent from strip mines, and 2 percent from auger mines. Underground production increased 9 percent to 28.2 million tons.

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[6] Pharr, Richard F., Utilization of Rock Materials in Lower Chesapeake Bay Bridge-Tunnel. Virginia Minerals, v. 7, No. 4, November 1961, pp. 1–10.

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Pit and Quarry. Southern Materials Co. Heads Aggregate Supply for Virginia Bridge Project. V. 54, No. 6, p. 23.

[7] The Commonwealth, The Magazine of Virginia. Nuclear Test Successful. V. 28, No. 8, August 1961, p. 32.

The total number of mines was 1,179, 89 less than in 1960. Of this number, 1,109 were underground mines, 36 were strip mines, and 34 were auger mines. Mechanically loaded coal comprised nearly half the total underground output; 83 percent of the mechanically loaded tonnage was by 139 mobile loading machines, 21 less than in 1960. Thirty continuous mining machines cut and loaded most of the remainder. A small quantity was hand-loaded on face or room conveyors. Equipment used at underground mines included 902 cutting machines, 1,350 handheld and postmounted coal drills, 19 mobile drills, and 189 roof and rock drills. Deep-mine haulage consisted of 1,060 trolley, battery, and other locomotives, 187 rubber-tired tractors, and 7,652 mine cars. The main line rail track totaled 120.9 miles and all other track 48.8 miles. Intermediate haulage facilities included 252 shuttle cars, 70 shuttle buggies, and 118 main conveyors averaging 1,980 feet in length.

Coal mechanically cleaned totaled 15 million short tons or 50 percent of the total coal produced, compared with 48 percent in 1960, reflecting a greater demand for a better prepared product. Eighty-seven percent was prepared by wetwashing other than jigs. Twenty-two cleaning plants were in operation during the year. The quantity of coal crushed comprised 28 percent of the total, compared with 31 percent in 1960 and 17 percent in 1959. Dust-allaying and antifreezing preparations were used to treat 14 percent of the total coal mined. Treatment with oil comprised 87 percent of the total. Other materials used included calcium chloride and petroleum asphalt.

Equipment used at stripping operations included 64 power shovels (8 diesel electric, 55 diesel, and 1 gasoline, mostly under 3-cubic-yard capacity), 52 bulldozers, 15 horizontal and 4 vertical overburden drills, and 70 trucks or tractor trailers. Equipment at auger mines included 36 augers, 1 diesel-power shovel, 31 bulldozers, 4 power drills, and 20 trucks or tractor trailers.

According to final data, total number of man-hours worked at bituminous coal mines in 1960 was 21,069,688. The average number of men totaled 13,145, and they worked an average of 207 active days at 1,268 mines. Injuries included 24 fatal accidents and 885 lost-time (nonfatal) accidents. Injury severity rate per million hours dropped to 42.00 compared with 46.63 in 1959.

A new 1.2-million-ton coal mine was being developed by Republic Steel Co. and Island Creek Coal Co. in Buchanan County near Grundy. Norfolk & Western Railway Co. doubled capacity of its Lambert's Point coal pier at Norfolk. Increased facilities consisted of two traveling ship loaders, which increased the maximum dumping rate at the pier from 10,000 to 20,000 tons per hour. The Railway also was building a fleet of 85-ton hopper cars. The new facilities and equipment, which emphasized the Railway's confidence in coal's future, were to increase flexibility to meet expanded domestic and foreign shipments.

TABLE 3.—Coal (bituminous) production and value, by counties

(Thousand short tons and thousand dollars)

County	1960		1961	
	Quantity	Value [1]	Quantity	Value [1]
Buchanan	10,568	$44,216	10,949	$41,072
Dickenson	7,120	29,665	8,438	34,901
Lee	616	2,261	453	1,626
Montgomery	9	33	12	41
Russell	2,284	11,104	1,935	9,149
Scott	16	70	17	76
Tazewell	1,751	10,688	933	4,981
Wise	5,474	24,686	7,595	34,275
Total	27,838	122,723	30,332	126,121

[1] Value received or charged for coal f.o.b. mine, including selling cost. (Includes value for coal not sold but used by producer, such as mine fuel, and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

Coke.—Wise County was the only coke producing county in the State. Five companies produced beehive coke in more than 660 ovens, including 1 battery of Mitchell or rectangular ovens. The annual coke production capacity was approximately 375,000 short tons. No slot-type ovens were operated, and no byproducts were recovered.

Fuel Briquets and Packaged Fuel.—One firm produced packaged fuel. Shipments of fuel briquets into Virginia totaled 29,942 tons, a decrease of 18 percent from 1960 shipments.

Petroleum and Natural Gas.—Production of petroleum and natural gas was small and mostly of local significance. As in 1960, no oil wells were completed, and no discoveries of oil were made. Petroleum was produced only from the Rose Hill field, Lee County, where output was larger than in 1960. Production of natural gas was approximately the same as that of 1960. Eight successful natural gas wells were completed, as well as eight dry holes, including one dry hole on the Coastal Plain about 18 miles northeast of Richmond and 3 miles south of Manquin. Of the eight completed gas wells, six were in Buchanan County, and one each, in Wise and Tazewell Counties. Formations from which natural gas was obtained included the Big Lime, Berea Sand, and the Ravencliff Sand. According to the American Gas Association, reserves of natural gas at the end of 1961 totaled 34,062 million cubic feet, a slight increase over reserves at the end of 1960.

All reserves represented free gas, not in contact with crude oil in the reservoir, or so-called nonassociated reserves.

Distribution of natural gas to consumers was through three pipeline companies—Hope Natural Gas Co., Kentucky-West Virginia Gas Co., and United Fuel Gas Co. Four firms were active in drilling for natural gas during the year. These were United Producing Co., Inc., United Fuel Gas Co., Cabot Corp., and Clinchfield Coal Co. The wildcat oil test near Manquin on the Atlantic Coastal Plain in King William County was drilled to a total depth of 3,278 feet. Although the well was dry, the drilling had significance because it indicated the presence of a hitherto unknown Triassic basin.

American Oil Co. operated its petroleum refinery at Goodwin Neck near Yorktown, York County. Its facilities included skimming, cracking, and coking operations. American Oil Co. at Yorktown and Texaco Experiment, Inc., at Richmond, Henrico County, operated research laboratories.

NONMETALS

Aplite.—Production of aplite by four firms in Amherst, Hanover, and Nelson Counties totaled 97,465 long tons valued at $650,770. This was the first year of full production for Metal and Thermit Corp. in Hanover County, near Montpelier. Output of aplite by this company was used entirely in the manufacture of glass. Sizable tonnages of aplite, however, were consumed for roofing granules, as concrete aggregate, and in the manufacture of brick and block—increasing uses in recent years. Aplite for these purposes is considered under the heading of miscellaneous stone in the stone section of this chapter.

Cement.—Stimulated by greater construction activity, shipments of portland and masonry cement each increased 13 percent over 1960. Portland cement was produced by two firms operating three plants in Botetourt, Norfolk, and Augusta Counties. Two of the plants used the dry process and the third, the wet process. Two of the three plants manufacturing portland cement also produced masonry cement, and another firm, in Warren County, produced masonry cement only. The cement companies mined limestone, shale, and calcareous marl for use in their own operations. Other materials used in cement manufacturing included sand, gypsum, mill-scale and pyrite cinders, air-entraining compounds, and grinding aids. The chief type of portland cement manufactured and marketed was general-use and moderate-heat cement (Types I–II). A considerable quantity of high-early-strength cement also was produced. All shipments except a small quantity by boat were made by railroads. Most of the cement was shipped in bulk, and the balance in paper bags.

The distribution of portland cement by types of consumer was as follows: 52 percent to ready-mixed concrete companies (55 percent in 1960); 20 percent to concrete product manufacturers (25 percent in 1960); 10 percent to building material dealers (10 percent in 1960); 10 percent to highway contractors (7 percent in 1960); and the remainder to other contractors, Federal, State, and local government agencies, and miscellaneous customers. Most of the portland cement shipments were made to Virginia, North Carolina, and West Virginia.

The bulk of masonry cement was shipped to Virginia, North Carolina, Maryland, and the District of Columbia, with smaller shipments to various Midwestern, Southern, and New England States.

Clays.—Output of clay rose 4 percent in quantity to 1.4 million short tons, a new record, although the total value was slightly less than in 1960. The production consisted entirely of miscellaneous clay or shale. Most of the clay was consumed in making building brick, but small quantities were used in making vitrified sewer pipe and flue linings, lightweight aggregate, and portland cement. Seventeen firms as in 1960, mined and processed clay from 22 mines in 17 counties. In order of value of output, the principal producing counties were Botetourt, Buckingham, Chesterfield, Nansemond, and Orange. According to preliminary data, 61 men worked 115,187 man-hours, with only 2 lost-time nonfatal accidents. The accident frequency rate per million man-hours was 17.36.

Over 100 samples of clay and other materials from the northern counties of Virginia were evaluated for their ceramic and nonceramic uses for possible commercial utilization. Types of clay and related substances analyzed included shale, mudstone, slate, phyllite, and schist.[8]

TABLE 4.—Clays sold or used by producers

Year	Short tons	Value	Year	Short tons	Value
1952–56 (average)	906,713	$910,645	1959	1,346,014	$1,396,433
1957	893,255	986,302	1960	1,347,766	1,394,665
1958	1,152,850	1,143,160	1961	1,406,201	1,332,165

Feldspar.—Production of feldspar increased 8 percent in quantity over that of 1960, but the value decreased slightly. One firm produced potash and soda feldspar from three mines in Bedford County for grinding at the company mill at Bedford. Pottery and enamel were the chief markets for the ground feldspar. Other uses included abrasives, welding-rod coating, and brick facing. Shipments of ground feldspar largely were to Maryland, Ohio, and New Jersey.

Gem Stones.—Gems and mineral specimens gathered by mineral collectors and hobbyists included amazonite in Amelia County.

Gypsum.—Production of crude gypsum at Plasterco, in Washington County, by United States Gypsum Co. continued. Output rose compared with 1960. A new underground mine in Smyth County, 18 miles from Saltville, was under development in the last half of the year. Calcined gypsum and plasterboard and other gypsum products were manufactured at Plasterco by United States Gypsum Co. This firm also calcined domestic and imported gypsum at a mill in Norfolk. Several firms in the Norfolk area imported crude gypsum from Nova Scotia for grinding for use chiefly as an agricultural land dressing, particularly by peanut farmers.

Kyanite.—Production of crude ore increased 5 percent and sales of refined kyanite increased 9 percent over 1960. Two mines and flotation plants and a pulverizing mill were operated by Kyanite Mining Corporation. One mine and flotation plant was in Buchingham County and the other in Prince Edward County. The pulverizing mill was in Appomattox County. Output was marketed to the refractories and other ceramic industries.

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[8] Calver, James L., Howard B. Hamlin, and Robert S. Wood. Analyses of Clay, Shale, and Related Materials—Northern Counties. Virginia Division of Minerals Min. Res. Rept. 2, Charlottesville, 1961, 194 pp.

Lime.—Lime production increased 4 percent in quantity and 7 percent in value compared with 1960. The quantity was 3 percent less than in 1959, the record year, but the value topped that of 1959 by 5 percent. Of the total production, 92 percent of which was quicklime, chemical and industrial uses comprised 95 percent. Although both agricultural and chemical lime production increased, building lime output was less than in 1960. Two companies used shell in the manufacture of lime. Eleven companies burned lime in 1961 compared with 10 in 1960. Included was a paper manufacturer in Alleghany County which produced captive lime. The principal lime-producing counties were Giles, Smyth, Alleghany, and Shenandoah. Natural gas, bituminous coal, and coke were used as fuel to fire the kilns, which included pot, shaft, rotary, and vertical-type kilns. Both batch and continuous hydrators were used. The annual lime-burning capacity of the 11 firms totaled nearly 900,000 short tons.

Quicklime was used in manufacturing calcium carbide, in making paper and whiting, in the manufacturing alkalies, for flux in steel making, and for other purposes. Hydrated lime was used for purifying water, tanning leather, treating sewage and trade wastes, and other uses. Lime used in building was mostly hydrated. Both quicklime and hydrated lime were used for agricultural purposes, although the major tonnage was hydrated.

TABLE 5.—Lime sold or used by producers, by uses

Year	Agricultural		Building		Chemical and other industrial		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1952–56 (average)	20,516	$246,379	9,019	$103,731	444,870	$4,646,210	474,405	$4,996,320
1957	[1] 17,897	354,287	[1] 4,190	51,995	[1] 35,250	5,622,860	510,216	6,029,142
1958	(2)	(2)	(2)	(2)	438,449	5,119,929	471,313	5,532,833
1959	29,519	351,955	5,345	73,628	730,376	7,742,829	765,240	8,168,412
1960	27,011	319,829	5,541	82,753	678,487	7,625,404	711,039	8,027,986
1961	28,760	375,489	4,932	72,584	705,014	8,147,552	738,706	8,595,625

[1] Excludes production of quicklime to avoid disclosing individual company confidential data; included in total.

[2] Figure withheld to avoid disclosing individual company confidential data; included in total.

Mica.—Small quantities of mica from Amelia and Henry Counties were sold through GSA Spruce Pine, N.C. and Franklin, N.H. Purchase Depots. Domestic and foreign scrap mica were wet ground by Richmond Mica Corp., Newport News, for consumption in paint, rubber, wallpaper, plastics and other products. Factory scrap and mine scrap and flake mica were purchased for grinding.

Nitrogen Compounds.—Allied Chemical Corp., Nitrogen Division, Hopewell, Prince George County, manufactured nitrogen compounds for use chiefly as fertilizer ingredients. Included among products manufactured were ammonia, urea solution, and ammonium sulfate.

Perlite.—A plant at Hopewell, Prince George County, expanded perlite obtained from Colorado for use chiefly in building plaster and concrete aggregate.

Pyrites.—General Chemical Division, Allied Chemical Corp., mined pyrites (pyrrhotite) at its Gossan mine in Carroll County. Production, which was only slightly under that of 1960, was shipped to Pulaski, where it was consumed in the manufacture of sulfuric acid.

Salt.—One company produced salt brine at Saltville, Smyth County. Production was slightly less than in 1960. The product was used chiefly for making chlorine, soda ash, and other chemicals.

Sand and Gravel.—Stimulated by increased highway construction and the impact of the Chesapeake Bay Bridge-Tunnel project, tonnage and value of sand and gravel production rose 28 and 29 percent, respectively, to new records; production and value were 16 and 19 percent greater than in 1959, the previous record year. Output for paving and building increased 24 and 10 percent, respectively, over 1960, and comprised 85 percent of the commercial production (50 percent paving, 35 percent building). Other products included glass, molding, engine, filtration, railroad ballast, fill, and miscellaneous sand (including sand for ice control). Gravel comprised 56 percent of the total output compared with 50 percent in 1960. The average value per ton remained at $1.49. Output was reported from 30 counties. Commercial output comprised 97 percent of the total production; the remainder was State, Federal, and local government production. Thirty-nine commercial producers operated 46 sand and (or) gravel pits in 25 counties. The leading counties were Henrico, Fairfax, Chesterfield, Prince George, and Princess Anne. Production in these five counties represented 78 percent of the total Virginia output.

Soapstone.—Two companies mined, crushed, and ground soapstone—one in Franklin and one in Nelson and Albemarle Counties. Production of crude and sales of ground material were substantially less than in 1960. The product was used in roofing, rubber, foundry facings, and insecticides. Soapstone used as a dimension stone is included with miscellaneous stone in the stone section of this chapter.

Stone.—A vigorous highway and building construction program, including the Chesapeake Bay Bridge-Tunnel, brought about an 18-percent increase in output of stone over 1960 to new record highs in tonnage and value. Stone ranked second only to coal in both tonnage and value among minerals produced in Virginia. Of the total output, 69 percent was used for concrete aggregate and in highway construction, 9 percent for cement, and 6 percent for lime. Many varieties of stone were produced, including limestone, granite, basalt, sandstone, marble, miscellaneous stone (including soapstone, greenstone, and crushed and broken aplite), calcareous marl, slate, and shell. The principal uses for shell were as agricultural land dressing (finely ground) and for lime manufacture. Shell was a byproduct of the oyster and mollusk fisheries industries. Slate was quarried and prepared for use as roofing granules by one firm in Rockingham County. Two firms in Nelson County mined aplite from which roofing granules were prepared. Limestone comprised 61 percent of the total stone; granite, 23 percent; and basalt, 12 percent. Crushed and broken stone comprised most of the output. However, a small quantity of dimen-

TABLE 6.—Sand and gravel sold or used by producers, by classes of operations and uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Building	1,379,428	$1,734,400	1,516,508	$2,112,447
Paving	1,834,581	2,478,685	2,067,742	3,097,175
Engine	33,862	49,827	35,940	46,731
Fill	138,294	80,345	282,650	147,742
Ground	(1)	(1)	189	758
Other [2]	337,595	794,033	335,966	816,607
Total	3,723,760	5,137,290	4,238,995	6,221,460
Gravel:				
Building	1,665,493	2,504,531	1,868,146	2,935,594
Paving	2,051,559	3,668,291	2,693,790	4,760,018
Other [3]	9,430	9,415	767,009	598,603
Total	3,726,482	6,182,237	5,328,945	8,294,215
Total sand and gravel	7,450,242	11,319,527	9,567,940	14,515,675
Government-and-contractor operations:				
Sand:				
Paving	67,647	25,015	95,982	40,739
Other	25,468	10,187	18,191	7,276
Total	93,115	35,202	114,173	48,015
Gravel:				
Building	43,814	3,245		
Paving	79,229	73,835	145,385	115,612
Other			12,000	18,000
Total	123,043	77,080	157,385	133,612
Total sand and gravel	216,158	112,282	271,558	181,627
Grand total	7,666,400	11,431,809	9,839,498	14,697,302

[1] Figure withheld to avoid disclosing individual company confidential data.
[2] Includes glass sand, molding sand, railroad ballast, filtration sand, grinding and polishing sand (1960), and ground sand (1960).
[3] Includes fill.

sion sandstone and dimension miscellaneous stone was quarried. In order of tonnage produced, the chief stone-quarrying counties were Loudoun, Fairfax, Frederick, Washington, and Greensville. Commercial stone was produced in 49 counties by 93 producers. Five State or municipal agencies in 11 counties produced Government-and-contractor stone. Four companies in three counties produced and marketed shell. Commercial stone producers for each type of stone were as follows: Limestone, 58 companies (65 quarries); granite, 11 companies (14 quarries); basalt, 9 companies (9 quarries); sandstone, 8 companies (8 quarries); marble, 1 company (1 quarry); miscellaneous stone, 4 companies (4 quarries); calcareous marl, 3 companies (3 quarries); and slate, 3 companies (3 quarries). The number of companies does not add to the total shown, as four firms produced more than one kind of stone. According to preliminary data, the average number of men working in quarries and mills (excluding officeworkers) totaled 3,650. These men worked a total of 7,890,723 hours; there were 4 fatal injuries and 160 lost-time nonfatal injuries. This injury experience compares with no fatalities and 234 nonfatal injuries in 1960, representing a substantial improvement in lost-time injuries. The injury frequency rate per million hours of exposure for fatalities was 0.51, and that for nonfatal injuries was 20.28.

A brief history of the Virginia dimension slate industry, including origin, occurrence, geology of the Arvonia-Buckingham area, bedding and cleavage, quarrying and processing, and uses and characteristics, was published.[9] The dimension stone deposits of Virginia Greenstone Co., Inc., and Alberene Stone Division of Georgia Marble Co. were described. History, including present and past producing localities, of soapstone and related deposits, geology, production, quarrying, milling, and uses were treated. Production and uses of ground soapstone also were discussed.[10] Prospecting and development was carried on by Coggins Granite Industries, Inc., to reopen a dimension stone quarry in diabase near Buena, Culpeper County.

TABLE 7.—Stone sold or used by producers, by kinds and uses

Kind and use	1960		1961	
	Short tons	Value	Short tons	Value
Dimension stone: Sandstone, all uses	401	$5,210	239	$3,475
Crushed and broken stone:				
Granite:				
Concrete and roadstone	[1] 3,787,947	[1] 5,363,546	4,637,652	7,245,935
Riprap	(2)	(2)	[3] 575,317	[3] 1,095,510
Basalt: Concrete and roadstone [4]	2,370,067	3,622,657	2,777,172	4,361,328
Limestone:				
Riprap	(5)	(5)	5,976	7,760
Fluxing stone	622,558	1,071,472	972,454	1,697,462
Concrete and roadstone	6,650,119	8,872,155	8,013,598	10,934,629
Railroad ballast	[5] 215,578	[5] 260,393	260,916	326,758
Agricultural	761,163	1,601,295	875,293	1,785,132
Miscellaneous	4,106,392	6,576,757	3,777,122	6,061,073
Sandstone: All uses	368,646	673,051	515,225	925,425
Shell: Miscellaneous uses	13,999	78,890	14,460	88,375
Undistributed [6]	461,352	4,893,092	508,214	4,673,337
Total	19,358,222	33,018,518	22,933,638	39,206,199

[1] Includes riprap and railroad ballast.
[2] Included in concrete and roadstone.
[3] Includes railroad ballast and miscellaneous uses.
[4] Includes railroad ballast.
[5] Riprap included with railroad ballast.
[6] Includes dimension and crushed and broken miscellaneous stone and slate, and crushed and broken calcareous marl and marble.

Sulfur.—Hydrogen sulfide was recovered from fuel gas and converted to sulfur by American Oil Co. at its Yorktown Refinery in York County. Production and shipments of sulfur both rose 10 percent compared with 1960.

METALS

Ferroalloys.—Ferromanganese was produced in two blast furnaces at Reusens near Lynchburg by E. J. Lavino & Co. Although production was less than in 1960, shipments rose 13 percent.

Iron and Steel.—Ingot and casting steel was produced by Newport News Shipbuilding & Drydock Co., Newport News, and Roanoke Electric Steel Corp., Roanoke.

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[9] Redden, J. A. Slate in Virginia. Miner. Ind. J., v. 8, No. 3, September 1961, pp. 1–5.

[10] Smith, James William. Talc, Soapstone, and Related Stone Deposits of Virginia. Virginia Minerals, v. 7, No. 2, April 1961, pp. 1–8.

Iron Ore (Pigment Material).—Crude natural iron oxide pigments, including sienna, umber, ocher, and other natural red and yellow iron oxides, and finished iron oxide pigments were produced in Pulaski County. Another company produced chiefly natural red iron oxide and a wide variety of finished, natural, and manufactured pigments near Henry in Franklin County.

Lead and Zinc.—Output of recoverable zinc rose to 29,200 short tons valued at $6.7 million, both new records, 8-percent higher in tonnage than the previous record of 27,000 short tons in 1938, and 27-percent higher in value than the previous record established in 1957. The increase was due primarily to almost continuous operation throughout the year and the need of New Jersey Zinc Co. to replace output lost when one of its mines in Tennessee hit an underground watercourse and was flooded. Production of recoverable lead, virtually a byproduct of zinc, also increased to the highest point since 1954. The average values per ton for both lead and zinc, however, were lower than in 1960. Zinc-lead ores from Wythe County and zinc-ore from Rockingham County were concentrated at mills at Austinville and Timberville, respectively. Ore from both the Ivanhoe and Austinville mines was treated at the Austinville mill. Zinc concentrate was shipped for treatment to Josephtown and Palmerton, Pa. and to East Chicago, Ind., Lead concentrate was shipped to Carteret, N.J., and to Japan.

TABLE 8.—Mine production of recoverable silver, lead, and zinc

Year	Silver		Lead		Zinc	
	Troy ounces	Value	Short tons	Value	Short tons	Value [1]
1952–56 (average)	[2] 1,666	[2] $1,508	3,386	$996,251	16,870	$4,318,445
1957	1,745	1,579	3,143	898,898	23,080	5,277,476
1958	2,023	1,831	2,934	686,556	18,472	3,807,853
1959	866	784	2,770	637,100	20,334	4,661,792
1960			2,152	503,568	19,885	5,142,275
1961			3,733	768,998	29,163	6,726,462

[1] Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

[2] Average of 1953, 1954, 1955, and 1956; no output reported in 1952

Titanium Concentrate.—Production of titanium concentrate was about one-eighth less than in 1960. Output consisted chiefly of ilmenite, although a small quantity of rutile was recovered. American Cyanamid Co. at Piney River, Amherst County, produced ilmenite; Metal and Thermit Corp. produced both rutile and ilmenite at its plant near Montpelier, Hanover County. The chief use for ilmenite was in making titanium dioxide pigments and rutile was used mainly in welding rod coatings.

REVIEW BY COUNTIES

Mineral output was reported from 72 of the 98 counties. Production of stone was reported from 54 counties. Government-and-contractor sand and gravel was mined by the Virginia Department of Highways in seven counties: Accomack, Buchanan, Nelson, Northampton, Northumberland, Pittsylvania, and Rockingham. Output was mostly by State highway crews, although a sizable percentage was praduced under contract. The entire output was washed and screened or otherwise prepared. Henrico County Highway Department also mined sand and gravel for paving. Most Government-and-contractor sand and gravel was used for paving and maintenance of roads and streets.

TABLE 9.—Value of mineral production in Virginia, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value[2]
Accomack	$9,383	$20,042	Sand and gravel.
Albermarle	(3)	(3)	Stone, soapstone.
Alleghany	(3)	(3)	Lime, stone.
Amelia	1,116	(3)	Mica, gem stones.
Amherst	(3)	(3)	Titanium concentrate, aplite, stone, sand and gravel.
Appomattox	61,119	63,410	Stone.
Augusta	(3)	(3)	Cement, stone, clays.
Bath	49,751	129,127	Stone.
Bedford	(3)	(3)	Stone, feldspar.
Bland	7,113	5,498	Stone.
Botetourt	(3)	(3)	Cement, stone, clays.
Brunswick	(3)	(3)	Stone, clays.
Buchanan[4]	[5] 44,215,698	41,107,650	Coal, sand and gravel, natural gas.
Buckingham	2,099,748	2,116,551	Stone, kyanite, clays.
Campbell	1,310,033	1,410,628	Stone.
Caroline	(3)	(3)	Sand and gravel.
Carroll	(3)	(3)	Pyrites, stone.
Chesterfield	(3)	(3)	Sand and gravel, clays.
Clarke	81,550	115,025	Stone.
Craig	(3)	(3)	Sand and gravel, stone.
Culpepper	(3)	(3)	Stone, sand and gravel.
Dickenson[4]	29,665,478	34,901,399	Coal, natural gas.
Dinwiddie	(3)	(3)	Stone, clays.
Fairfax	4,011,194	5,105,868	Sand and gravel, stone.
Fauquier	449,084	638,242	Stone.
Franklin	(3)	(3)	Soapstone.
Frederick	2,095,764	2,944,893	Stone, lime, sand and gravel, clays.
Giles	(3)	(3)	Lime, stone.
Goochland	(3)	928,500	Stone.
Greensville	(3)	(3)	Do.
Hanover	(3)	(3)	Stone, aplite, titanium concentrate.
Henrico	3,370,294	4,313,706	Sand and gravel, stone, clays.
Henry	(3)	(3)	Stone, mica.
Highland	25,576	27,667	Stone.
Isle of Wight	65,965	(3)	Lime, sand and gravel, stone.
King William	(3)	(3)	Sand and gravel.
Lee[6]	2,622,997	1,998,449	Coal, stone, petroleum.
Loudoun	2,766,166	2,608,786	Stone.
Louisa	(3)	(3)	Do.
Madison	25	----------------	
Mecklenburg	(3)	(3)	Do.
Montgomery	[7] 251,002	329,886	Stone, coal, clays, sand and gravel.
Nansemond	(3)	(3)	Stone, clays.
Nelson	(3)	(3)	Stone, aplite, sand and gravel, soapstone.
Norfolk	(3)	(3)	Cement, lime, stone, sand and gravel.
Northampton	1,307	(3)	Sand and gravel.
Northumberland	11,500	12,500	Do.
Nottoway	195,000	365,000	Stone.
Orange	(3)	(3)	Clays.
Patrick	(3)	(3)	Stone.
Pittsylvania	(3)	(3)	Stone, sand and gravel.
Powhatan	(3)	----------------	
Prince Edward	(3)	(3)	Kyanite.
Prince George	1,036,174	1,041,061	Sand and gravel.
Prince William	(3)	(3)	Clays, stone.
Princess Anne	303,401	644,196	Sand and gravel.
Pulaski	(3)	(3)	Stone, iron ore (pigment material).
Roanoke	(3)	(3)	Stone, clays.
Rockbridge	744,917	1,007,453	Stone, sand and gravel, clays.
Rockingham	2,455,205	2,117,476	Zinc, stone, sand and gravel.
Russell	11,400,587	[8] 9,166,828	Coal, stone, clays, sand and gravel.
Scott	314,783	314,268	Stone, coal.
Shenandoah	(3)	(3)	Lime, stone.

See footnotes at end of table.

TABLE 9.—Value of mineral production in Virginia, by counties[1]—Continued

County	1960	1961	Minerals produced in 1961 in order of value[2]
Smyth	(3)	(3)	Salt, lime, stone, sand and gravel, clays.
Spotsylvania	(3)	(3)	Sand and gravel, stone.
Stafford	(3)	(3)	Sand and gravel.
Surry	(3)	(3)	Do.
Tazewell [8]	$10,758,145	$5,045,878	Coal, stone, lime, clays.
Warren	(3)	(3)	Cement, stone.
Washington	(3)	(3)	Stone, gypsum.
Westmoreland	(3)	105,000	Sand and gravel.
Wise [9]	24,686,050	34,274,928	Coal, stone.
Wythe	4,486,937	6,634,926	Zinc, lead, stone, sand and gravel.
York	------------	(3)	Sand and gravel.
Undistributed [10]	[7] 54,333,990	62,340,012	
Total	[7] 203,887,000	221,835,000	

[1] The following counties did not report production: Arlington, Charles City, Charlotte, Cumberland, Essex, Floyd, Fluvanna, Gloucester, Grayson, Greene, Halifax, James City, King and Queen, King George, Lancaster, Lunenburg, Mathews, Middlesex, New Kent, News, Page, Rappahannock, Richmond, Southampton, and Sussex.

[2] Value of natural gas and petroleum included with "Undistributed."

[3] Figure withheld to avoid disclosing individual company confidential data.

[4] Excludes natural gas; included with "Undistributed."

[5] Excludes sand and gravel; included with "Undistributed."

[6] Excludes petroleum; included with "Undistributed."

[7] Revised figure.

[8] Excludes stone and clays; included with "Undistributed."

[9] Excludes stone; included with "Undistributed."

[10] Includes value of natural gas and petroleum; part of value of gem stones and sand and gravel; and values indicated by footnote 3.

The Virginia Department of Highways also quarried and crushed sandstone in Bath County, and limestone in Augusta, Bath, Botetourt, Clarke, Highland, and Roanoke Counties for highway construction and repair. The cities of Martinsville, Henry County, and Danville, Pittsylvania County, produced crushed granite, and the city of Wytheville, Wythe County, crushed limestone for street construction and maintenance.

Albemarle.—Granite was produced at the Red Hill quarry of Superior Stone Co., Division of Martin Marietta Corp. Basalt was quarried by Charlottesville Stone Co., near Charlottesville. Output of both quarries was crushed and sold for concrete aggregate and roadstone. Soapstone was produced at Alberene, and serpentinite was quarried near Schuyler by the Alberene Stone Division of Georgia Marble Co.

Alleghany.—West Virginia Pulp and Paper Co. operated a rotary limekiln at Covington to provide lime for use in the manufacture of paper. W. G. Mathews, Jr., Inc., quarried limestone near Lowmoor for use as concrete aggregate, roadstone, and agstone.

Amelia.—Joe L. Snyder produced full-trimmed mica from Baltzley No. 5 and No. 6 mines. This mica was sold through the GSA Purchase Depot at Franklin, N.H.

Amherst.—Riverton Lime & Stone Co., Division of Chadbourn Gotham, Inc., produced aplite near Piney River. The finished product (processed in Nelson County) was consumed in glass manufacture, for roofing granules, and as crushed stone for concrete aggregate.

Ilmenite, a titanium concentrate, was recovered by American Cyanamid Co. from open-pit operations near Piney River for consumption at its nearby titanium-pigment plant.

Washed and screened building sand was produced at a dredging operation north of Lynchburg by Smiley Sand Co.

Appomattox.—Virginia Department of Agriculture and Immigration mined and processed limestone for use as soil-conditioning material. Kyanite Mining Corp. operated a grinding plant at Pamplin for further processing kyanite flotation concentrate from its Dillwyn and Cullen plants.

Augusta.—Captive limestone and shale were mined by Lehigh Portland Cement Co. at Fordwick. The company produced general-use and high-early-strength portland cement by the dry process at six kilns. Masonry cement also was produced.

Belmont Trap Rock Co., Inc., August Stone Corp., and Valley Stone Co., near Staunton, quarried, crushed, and sized limestone for concrete aggregate and roadstone. Limestone was ground for agricultural purposes by the Virginia Department of Agriculture and Immigration.

Bedford.—Clinchfield Sand & Feldspar Corp. mined potash and soda feldspar from three mines and ground it for use mostly in making pottery and enamel. Maryland, New Jersey, Ohio, and Pennsylvania were the chief consuming States.

Limestone was quarried by Blue Ridge Stone Corp. for use as concrete aggregate, roadstone, railroad ballast, and agstone. An illustrated description of the crushing and conveying equipment of this company's quarry and mill operation near Bedford was published.[11]

Bland.—Bland Correctional Farm quarried limestone for riprap near White Gate.

Botetourt.—Botetourt was the chief limestone producing county. Both tonnage and value increased compared with 1960. James River Hydrate & Supply Co. and Liberty Limestone Corp. operated three quarries near Buchanan. Uses included concrete aggregate and roadstone, filler for asphalt and fertilizers, metallurgical flux, agricultural stone, railroad ballast, mineral food for animals, and stone sand. Limestone also was produced by Lone Star Cement Corp. for use in making cement at its Cloverdale Plant, where general-use and high-early-strength portland cement and masonry cement were produced at four 340- by 9-foot rotary kilns. Most of the portland cement was non-air-entrained.

Production of clay declined slightly in both quantity and value. The county was the second largest clay producing county. Miscellaneous clay and shale for use in heavy clay products and lightweight aggregate was produced by Webster Brick Co., Inc., and Virginia Lightweight Aggregate Corp., respectively, at Webster near Roanoke.

Brunswick.—Southern Materials Co., Inc., quarried and prepared granite for concrete aggregate and roadstone and riprap at its Rawlings Quarry. Brick & Tile Corp. mined miscellaneous clay and shale from four clay pits near Lawrenceville for use in manufacturing building brick.

Buchanan.—Buchanan ranked first among Virginia coal-producing counties, mining 36 percent of the State total. There were 677 underground mines and 11 auger mines. Nearly all the coal came from underground mines. Equipment used at underground mines included

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[11] Pit and Quarry, v. 54, No. 6, December 1961, pp. 70–71.

790 handheld and postmounted drills and 26 rock drills. Haulage facilities included 654 locomotives, 125 rubber-tired tractors, 4,018 mine cars, 39 shuttle cars, 45 shuttle buggies, and 8 conveyors. Miles of track included 50.6 miles of main-line haulage and 13.5 miles of other haulage. Four hundred and eighty-eight cutting machines were in operation. Equipment at auger mines included 11 augers, 10 bulldozers, 2 power drills, and 4 trucks. The principal producers of bituminous coal included Harmon Mining Corp., Island Creek Coal Co., Black Diamond Coal Co., Bear Coal Co., and Willmore Coal Co. Coal was recovered principally from the Red Ash, Blair, Splashdam, and Jewell Ridge seams.

A new corporation, Beatrice Pocahontas Co., was to be formed jointly by Republic Steel Corp and Island Creek Coal Co. to develop and operate a new 1,200,000-ton-per-year coal mine near Grundy. Mine shafts 1,400 feet deep were to be sunk on timberlands owned by Georgia-Pacific Corp., and the mine and plant were to be equipped with modern mining and preparation equipment. The coal, which is a high-quality low-ash, low-sulfur product, will be blended with high-volatile coal for metallurgical purposes, and the manufacture of coke for blast-furnace use. Republic Steel Corp was to consume most of the production of the mine at its seven steel plants in Ohio, Illinois, and New York; the remainder would be marketed elsewhere by Island Creek Coal Sales Co., a subsidiary of Island Creek Coal Co.[12]

United Fuel Gas Co., Cabot Corp., and United Producing Co. completed six successful natural gas wells in the Big Lime, Ravencliff sand and Berea sand formations. Most of the gas produced was delivered to the pipelines of Hope Natural Gas Co., and the remainder to Atlantic Seaboard Line of United Fuel Gas Co.

Buckingham.—Arvonia-Buckingham Slate Co., Inc., and LeSueur-Richmond Slate Corp. quarried, sawed, and split slate at quarries and mills near Arvonia. Roofing and electrical slate, and flagging were produced. LeSueur-Richmond Slate Corp. was developing a new quarry for operation in 1962. Roofing granules were prepared from crushed slate by Blue Ridge Slate Corp. from its Dutch Gap quarry near New Canton.

Kyanite Mining Corp. produced kyanite at its Willis Mountain mine and Dillwyn mill for sale to refractories and other ceramic manufacturers.

The county ranked first among the State's clay-producing counties. Solite Corp. mined and processed miscellaneous clay and shale at Bremo Bluff for use in making lightweight aggregate.

Campbell.—Limestone was quarried and crushed for concrete aggregate and roadstone by Blue Ridge Stone Corp., near Lynchburg, and Rockydale Stone Service Corp., near Concord. Virginia Greenstone Co. Inc., Lynchburg, quarried and marketed dressed building stone, refractory oven hearths, rubble, and flagging. Some crushed and broken stone also was sold for walks and road fill.

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[12] Mining Congress Journal. Republic Steel and Island Creek Will Develop New Virginia Coal Mine. V. 47, No. 7, July 1961, p. 66.
Pittsburgh-Post Gazette and Sun Telegraph, Dec. 1, 1961, p. 28.

Caroline.—Torrence & Wright produced prepared and bank-run sand and gravel for building at a stationary plant near Milford.

Carroll.—General Chemical Division, Allied Chemical Corp. produced lump and fine pyrrhotite concentrate (pyrites) at its Gossan Mine near Galax. The pyrrhotite was consumed in the manufacture of sulfuric acid at the company's Pulaski plant. Intensive beneficiation tests were made on ore from the Great Gossan Lead to determine possibilities for the recovery, chiefly, of iron ore. Processing methods similar to those used for Sudbury (Ontario) Canadian ores were studied owing to the similarity of the Sudbury and the Great Gossan Lead deposits.[13]

Crushed sandstone for use as concrete aggregate and roadstone was produced by Newman Brothers near Sylvatus.

Chesterfield.—Southern Materials Co., Inc., operated a dredge at Kingsland Reach on the James River, producing washed and screened sand and gravel for building and highway purposes. Both a dredging and a wet-pit operation supplied a Southern Materials Co. sand and gravel plant at Chester. A description of these two types of recovery was published.[14]

Redford Brick Co., Richmond Clay Products Corp., and Southside Brick Works, Inc., produced miscellaneous clay or shale at open-pit mines near Richmond for making building brick and tile. Richmond Clay Products Corp. was in receivership for a large part of the year.

Clarke.—Calcareous marl was mined, pulverized, and air-dried for agricultural use by J. C. Digges and Sons, White Post, and Elmer Kenney, Jr., Lime Co. at Mellwood near Berryville. Stuart M. Perry, Inc., quarried and crushed limestone for concrete aggregate and roadstone near Berryville.

Craig.—Castle Sands Co., New Castle, quarried sandstone for use in masonry cement, for filtration, and for various chemical uses.

Culpeper.—Fredericksburg Sand & Gravel Co., Inc. (formerly Culpeper Sand Co., Inc.) produced sand for building, paving, and ice control from an open pit near Culpeper. Prospecting and development were carried on by Coggins Granite Industries, Inc., to reopen a dimension stone quarry in diabase near Buena.

Dickenson.—Production of bituminous coal rose 19 percent to 8.4 million short tons valued at $34.9 million. The county ranked second among coal-producing counties. As in 1960, 98 percent of the tonnage came from underground mines and the balance from strip and auger mines. Drilling equipment in underground mining included 128 handheld and postmounted drills, 19 mobile drills, and 31 rock drills. Haulage equipment included 83 locomotives, 12 rubber-tired tractors, 760 mine cars, 77 shuttle cars, 4 shuttle buggies, and 41 main conveyors. Strip-mine equipment included 2 diesel-electric and 10 diesel-powered shovels, 12 under-3-cubic-yard carryall scrapers, 5 bulldozers, 1 horizontal drill, and 8 trucks. Auger-mine equipment included three augers, one bulldozer, and three trucks. Chief producers included Clinchfield Coal Co., Baker Coal Co., and Contracting Enterprises, Inc. Production largely was from the Upper Banner, Clintwood, and Lower Banner seams. Mining layout and methods, mining equipment (including photo reproductions), and preparation methods at the Clinchfield Coal Co. Moss No. 3 coal mine were described.[15]

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[13] Coiner, R. M., and J. Richard Lucas. The Largest Undeveloped Sulfide Ore Body in Eastern United States: A Beneficiation Progress Report. Miner. Ind. J., v. 8, No. 4, December 1961, pp. 1–6.

[14] Pit and Quarry. Virginia Plant's Twin Feed Systems Provide Steady Material Flow. V. 54, No. 2, August 1961, p. 85.

There was no drilling for oil or gas in the county in 1961. Natural gas production from the Big Lime and Devonian shale formations was delivered to the pipeline of Kentucky-West Virginia Gas Co. for distribution to consumers.

Dinwiddie.—Granite was quarried and crushed for roadstone by Southern Materials, Co., Inc., at its Jack quarry near Petersburg. A large quantity of riprap also was furnished to the Chesapeake Bay Bridge-Tunnel project. Daniels Brick and Tile Co., Inc., produced shale under contract at Pooles Siding for the manufacture of vitrified sewer pipe and flue linings at the company plant near Richmond.

Fairfax.—Fairfax County ranked second among sand and gravel producing counties, accounting for 21 percent of the State total. Output was almost entirely for building and paving. Most of the production was washed and screened. Among the larger producers were Modern Sand & Gravel Corp., Alexandria Sand & Gravel Co., Northern Virginia Construction Co., Inc., Virginia Sand & Gravel Co., Inc., and L. S. Sorber & Co.

W. E. Graham & Sons Division, Vulcan Materials Co., quarried and crushed granite for use as riprap, concrete aggregate and roadstone, railroad ballast, and stone sand. Diabase (traprock) was produced for concrete aggregate and roadstone by Fairfax Quarries, Inc., near Fairfax. Herbert Bryant, Inc., of Alexandria crushed oystershell for use as poultry grit.

Fauquier.—Riverton Lime & Stone Co., Division of Chadbourn, Gotham, Inc., (Paris) and Sanders Quarry, Inc., (formerly W. W. Sanders Quarry), Warrenton, quarried and crushed basalt (traprock) for use as concrete aggregate and roadstone. Limestone was quarried and crushed for concrete aggregate and roadstone by Millbrook Quarries, Inc., at its Broad Run plant. Irregularly shaped sandstone for building purposes, flagstone, and wallstone was produced by J. W. Costello, The Plains. James Edward Corum also produced sandstone flagging at his Broad Run quarry.

Franklin.—Blue Ridge Talc Co., Inc., mined and ground soapstone at its King-Ramsey mine near Henry. Production was sold chiefly for foundry facing and insecticides. Manufactured iron oxide pigments also were produced by this firm at Henry.

Frederick.—Output of limestone increased substantially, and Frederick County rose to second in production among limestone-producing counties in the State. Output totaled 1.2 million short tons. Four firms, operating five quarries at Clearbrook, Winchester, Middletown, Stephens City, and Gore, mined and prepared limestone mostly for metallurgical flux, concrete aggregate, agstone, glass, lime, paper, and cement manufacture. Quicklime and hydrated lime were produced by M. J. Grove Lime Co., Division of The Flintkote Co., at Stephens City. The lime produced was sold for building, agricultural, chemical, and other uses. Companies producing limestone were W. S. Frey

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[15] Virginia Minerals. Highlights in the Virginia Coal Industry. V. 7, No. 3, August 1961, pp. 1–5.

Co., Inc., M. J. Grove Lime Co., Division of The Flintkote Co. (two quarries), Stuart M. Perry, Inc., and Terra Alta Limestone Co.

Glass sand was mined and processed near Gore by Virginia Glass Sand Corp., Winchester. A small quantity also was sold for masonry sand.

Shale was mined near Winchester by Shenandoah Brick & Tile Corp. for use in heavy-clay products, especially building brick.

Giles.—Output of limestone decreased 8 percent compared with 1960. Limestone was quarried and prepared principally for lime, concrete aggregate and roadstone, and agricultural lime by National Gypsum Co. and Standard Lime and Cement Co., Division Martin Marietta Corp., both near Kimballton, and Virginian Limestone Corp., and Ripplemead Lime Co., Inc., with quarries at Ripplemead. Standard Lime and Cement Division of Martin Marietta Co. and National Gypsum Co. produced lime in five coal-fired rotary kilns near Kimballton. Most of the output was for chemical and industrial uses. Masonry lime was produced in a coal-fired shaft kiln by Ripplemead Lime Co., Inc.

A new company, Minerals Development Corp., Roanoke, obtained several prospecting permits for iron ore in the Jefferson National Forest and diamond drilled in the vicinity of Narrows. The first cores were obtained on Pearis Mountain by a Salem firm. Some 2,000 feet of drilling was accomplished in 1961. About 20 holes were to be drilled in iron-bearing (hematitic) sandstone of Clinton age in Giles and Bland Counties, to determine if a more detailed drilling and survey program is warranted.

Goochland.—Quartzite was quarried and crushed for concrete aggregate and roadstone near Hylas by Royal Stone Corp. Boscobel Granite Corp. produced granite for roadstone at its Manakin quarry.

Greensville.—Granite was quarried and crushed for concrete aggregate and roadstone by Trego Stone Corp. near Skippers. Output increased sharply because of shipments to the Chesapeake Bay Bridge-Tunnel project.

Hanover.—General Crushed Stone Co. continued to operate the Verdon granite quarry near Doswell. Granite was marketed for concrete aggregate and highway construction, and as riprap and railroad ballast.

Titanium concentrate (ilmenite and rutile) and aplite were produced at its Beaver Dam plant near Montpelier by Metal & Thermit Corp. Milling equipment was installed for further processing of titanium concentrate. Additional equipment also was installed to increase aplite production. The open-pit operation consisted of three benches averaging 12 feet in height and 400 feet in width.

Henrico.—Henrico County ranked first among sand and gravel producing counties. Sand and gravel produced totaled 2.6 million short tons, or 26 percent of the State total. Southern Materials Co., Inc., produced building and paving sand and gravel at its No. 12 dredge in the James River. Other processed sand and gravel was produced in stationary plants by Commonwealth Sand & Gravel Corp., Carter Sand & Gravel Co., Inc., and West Sand & Gravel Co., Inc., for building and paving and for fill.

Granite was crushed by Tidewater Crushed Stone Co., Richmond, for riprap, concrete aggregate, and roadstone. Daniels Brick & Tile Co., Inc., produced miscellaneous clay near Richmond for use in the manufacture of vitrified sewer pipe and flue linings at its nearby plant.

Henry.—Snyder Stone Quarry and Martinsville Stone Corp. quarried and crushed granite for use in highway building and road maintenance. A. C. Wilson Construction Co. began the production of crushed stone from granite near Horse Pasture.

Isle of Wight.—Oystershell obtained as a byproduct of shell fisheries was burned to manufacture lime which was hydrated and sold for agricultural purposes by Battery Park Fish & Oyster Co. Zuni Sand Co. produced engine and building and fill sand at a stationary wet plant near Zuni.

King William.—Fox Co., at Aylett, produced building and paving sand and gravel and fill sand. Mattaponi Sand & Gravel Co., Inc., at Ashland, produced paving gravel.

A natural gas exploratory well drilled 18 miles northeast of Richmond and 3 miles south of Manquin reached a total depth of 3,278 feet and was presumably in Precambrian measures when completed. Although the well was dry, the discovery of an hitherto unknown Triassic basin was of interest.

Lee.—Production of bituminous coal dropped by more than one-quarter although 70 mines were active compared with 63 in 1960. Of the mines operating, 64 were underground mines, 3 were strip mines and 3 were auger mines. Underground operations accounted for 78 percent of the total production. Drilling equipment included 58 handheld and postmounted power drills and 51 cutting machines. Haulage equipment included 29 locomotives, 6 rubber-tired tractors, 219 mine cars, and 2 shuttle buggies. Main-line tract totaled 3.4 miles and other track, 0.6 mile. Strip-mine equipment included one diesel and one gasoline power shovel, two under-3-cubic-yard carryall scrapers, one bulldozer, one horizontal drill, and six trucks or tractor trailers. Auger mines used three augers, three bulldozers, and six trucks or tractor trailers. The principal coal producers were Wisco Coal Co., Betsy Darby Coal Co., Wright Mining Co., and The Virginia Lee Co., Inc. The principal coal seams mined were No. 5 and Nos. 11 and 12.

Kentucky-Virginia Stone Co., Inc., quarried limestone at its Wheeler quarry near Gibson Station for concrete aggregate and roadstone, agricultural uses, coal mine dust, and stone sand. Limestone for concrete aggregate, roadstone, and agricultural purposes also was produced by Woodway Stone Co. at Woodway.

The only petroleum producing area in Virginia was the Rose Hill field. Output was small and was consumed locally. Natural gas was not produced.

Loudoun.—Loudoun County was the chief basalt producing area in the State. Output totaled 1.6 million short tons. All of the stone was used in concrete aggregate and highway construction. Companies producing crushed basalt were Chantilly Crushed Stone, Inc., Arcola, and Virginia Trap Rock, Inc., and Arlington Stone & Macite Co., both near Leesburg. Bull Run Stone Co. also produced basalt near Manassas for highway and road construction.

Louisa.—Superior Stone Co., Division of Martin Marietta Corp. quarried, crushed, and screened limestone at Gordonsville for highway construction.

Mecklenburg.—Production of crushed granite at the Buggs Island quarry of W. E. Graham & Sons, Division of Vulcan Materials Co., nearly doubled compared with 1960. The output chiefly was used as riprap and in concrete aggregate and roadstone.

Montgomery.—Montgomery Limestone Corp. produced crushed stone for concrete aggregate and roadstone and agricultural use at its Ellett quarry near Christiansburg. A small quantity of semianthracite for domestic heating was mined in the Pulaski area by two producers; Jones & Keister Coal Co. was the larger of the two. Shale was mined at Elliston by Old Virginia Brick Co., Inc. for the manufacture of heavy-clay products. Velvet Sand Co., Inc., near Ironto, mined and crushed sandstone for use chiefly as masonry sand.

Nansemond.—Lone Star Cement Corp. mined calcareous marl at Chuckatuck for its South Norfolk cement plant, in Norfolk County. Clay also used in the manufacture of cement was dredged from the Nansemond River near Suffolk by the same firm. Webster Brick Co., Inc., mined miscellaneous clay near Suffolk for making building brick.

Nelson.—Alberene Stone Division of Georgia Marble Co. produced dimension and ground soapstone near Schuyler. Laboratory and architectural stone were prepared by sawing and splitting. Irregular-shaped slabs, averaging one-quarter inch in thickness, were marketed as flagging. Ground material and fine waste were sold for roofing, rubber, or other filler uses. Two quarries were operated in Nelson County and two in Albemarle County.

Consolidated Feldspar Department of International Minerals & Chemical Corp., and Buffalo Mines, Inc., mined aplite near Piney River. Crushing and grinding plants were operated by these two firms and by Riverton Lime & Stone Co., Division of Chadbourn-Gotham, Inc. The Riverton Lime & Stone Co. obtained its crude rock just across the county line in Amherst County. The bulk of the output of these firms was sold for use in the manufacture of glass. A sizable portion of the output of Riverton Lime & Stone Co. and Buffalo Mines, Inc., was marketed as concrete aggregate and roadstone, and roofing granules. Most of the aplite shipped for glass manufacture was destined for New Jersey, Ohio, West Virginia, Virginia, and Maryland.

Norfolk.—Portland cement was manufactured at South Norfolk from calcareous marl and clay mined in Nansemond County by Lone Star Cement Corp. Lime was manufactured at Norfolk by Reliance Fertilizer and Lime Corp. The shell used was purchased from J. H. Miles & Co., Inc., and Ballard Fish & Oyster Co., Inc., both in Norfolk. The hydrated product was sold for agricultural purposes.

Sand and gravel for railroad ballast, paving, and building construction was dredged near Norfolk by Interstate Division of Commonwealth Sand & Gravel Corp.

United States Gypsum Co. calcined domestic and imported gypsum at its Norfolk plant for use in plaster and other products. Several fertilizer plants in or near Norfolk imported crude gypsum from Nova Scotia for grinding for soil dressing, particularly for peanut crops.

Zinc sulfate, a zinc pigment, was produced by Virginia Smelting Co., West Norfolk.

Northampton.—Southern Materials Co., Inc., produced sand for paving for use in decks and other structural members of the Chesapeake Bay Bridge-Tunnel. Output was from a new portable operation on the Eastern Shore.

Nottoway.—Burkeville Stone Corp., Inc., quarried and prepared granite for highway road construction and concrete.

Orange.—Shale and mudstone were mined near Orange by Webster Brick Co., Inc., for use in manufacturing building brick. Production increased sharply compared with 1960.

Patrick.—Crushed limestone was sold for use as concrete aggregate and in highway construction by A. C. Wilson Construction Co., Martinsville. The quarry was near Patrick Springs.

Pittsylvania.—Superior Stone Co., Division of Martin Marietta Corp. quarried granite for use in concrete aggregate and highway construction and maintenance.

Marshall Sand Co. produced building sand at a stationary plant near Danville. Kendall Sand Works, also near Danville, produced prepared sand for paving use.

Virginia Solite Corp. manufactured lightweight aggregate at kilns near Leaksville Junction, using shale from a deposit that was just over the State line in North Carolina. Production was higher than in 1960.

Powhatan.—Virginia Stone & Construction Co. discontinued its Genito granite quarry near Powhatan.

Prince Edward.—Kyanite Mining Corp. produced kyanite at its Baker Mountain mine and processed it at the Cullen flotation plant operated by the company. The refined product was consumed in high-temperature refractories and special ceramic bodies.

Prince George.—Although production decreased, Prince George County ranked fourth among sand and gravel producing counties in the State. Sand and gravel for building, paving, and filtration was produced by Friend Sand & Gravel Co., Inc., at its Whitehill plant. Hitch Gravel Corp. produced bank-run gravel for paving purposes at its Powell's Creek plant. Southern Materials Co., Inc., produced building and paving sand and gravel at its Puddledock operation.

Virginia Perlite Corp., Hopewell, expanded smaller quantities of Colorado perlite for use as building plaster, concrete aggregate, and soil conditioning.

Nitrogen compounds for use in fertilizer were manufactured by Allied Chemical Corp., Nitrogen Division, at its Hopewell plant. Ammonium nitrate-limestone, urea solutions, solid and solution ammonium nitrate, and other nitrogen compounds were manufactured.

Prince William.—Diabase (traprock) was quarried and crushed for concrete aggregate, highway construction, and railroad ballast by Gainesville Stone Quarry, Inc., near Gainesville. Woodbridge Clay

Products Co. operated a claypit and two building brick plants near Manassas.

Princess Anne.—Production of sand and gravel increased 90 percent. The county ranked fifth among the sand and gravel producing counties. J. C. Jones Sand Co., Inc., and R. H. Baillio Co., both near Oceana, produced prepared building, paving, and traction sand, molding sand, filter sand, and sand for fertilizer filler. E. V. Williams Co., Inc., Tidewater Sand Co., Inc., and Little Creek Sand and Gravel Corp. operated stationary plants in or near Norfolk City. These firms produced building, paving and fill sand, sand for fertilizer filler, engine sand, and gravel fill.

Pulaski.—Radford Limestone Co., Inc., Radford, quarried limestone for processing at a stationary plant just over the county line in Montgomery County. The prepared material was marketed as aggregate and roadstone, agricultural lime, railroad ballast, and stone sand for concrete and masonry sand use. Salem Stone Corp. produced limestone for concrete aggregate and roadstone at its Newburn quarry near Dublin. The New River quarry of Montgomery Limestone Corp. was idle during the year.

American Pigment Corp. produced natural iron ore pigments near Hiwassee. Ocher, sienna, umber, and other natural yellow iron oxide pigments were mined and finished at a nearby plant. The same company produced manufactured red and yellow oxide pigments at a plant in Pulaski.

Roanoke.—Limestone for use as concrete aggregate and roadstone, and for agricultural purposes was quarried and crushed by Rockydale Quarries Corp., at Rockydale near Roanoke.

Rockbridge.—Charles W. Barger and Son and Lone Jack Limestone Co., Inc., quarried and crushed limestone for use as concrete aggregate and roadstone. Quartzite sold for manufacturing ferrosilicon was produced by W. G. Mathews, Jr., Inc., Natural Bridge Station (Greenlee). Glass, building, and traction sand was produced by Locher Silica Corp. near Glasgow. Locher Brick Co., Inc., Glasgow, mined miscellaneous clay near Glasgow for building brick.

Rockingham.—C. S. Mundy Quarries, Inc., Broadway, and Fred K. Betts, III, and R. Y. Frazier, both near Harrisonburg, quarried and crushed limestone for use chiefly as agricultural stone and concrete aggregate, and for use in highway construction. Jamison Black Marble Co., Inc., crushed marble for terrazzo near Harrisonburg. A. B. Torrence, Inc., produced paving gravel at a portable plant near Berrytown.

Tri-State Zinc, Inc., mined and concentrated zinc ore at the Bowers-Campbell mine and mill 2½ miles northwest of Timberville. The flotation concentrate was shipped to the St. Joseph Lead Co. smelter at Josephtown, Pa. The mine was worked by the room and pillar method.

Russell.—Production of bituminous coal again decline substantially. Of the 34 mines in operation, 3 were strip mines and 2 were auger mines. The underground mines accounted for 94 percent of the tonnage. Equipment used included 46 handheld and postmounted drills and 15 rock drills, 48 locomotives, 8 rubber-tired tractors, 754 mine cars, 34 shuttle cars, and 1 main conveyor. Main-line track totaled 5.5 miles and other track, 8.8 miles. Forty cutting machines were used. Principal producers were Clinchfield Coal Corp., Stallard-Lawson Coal Co., Smith Coal Co., and Meadows Coal Co. Coal was obtained chiefly from the Tiller, Upper Banner, Lower Banner, and Red Ash seams.

Limestone was produced for concrete aggregate and roadstone by Clinch River Quarries near St. Paul.

Lightweight Aggregate Division, Clinchfield Coal Corp. sharply increased its output of lightweight aggregate. The raw material was the waste from the preparation plant of the Moss No. 2 mine.

Scott.—Limestone was recovered from an underground mine near Duffield by Foote Mineral Co. for use as a reagent in making lithium products at its spodumene processing plant at Sunbright. The spodumene concentrate was mined and prepared at the company's Kings Mountain, N.C., quarry and plant. This firm began recovery of lithium aluminate dust formerly lost in stack gases, using two electrostatic precipitators. Over 50 tons of this dust was recovered daily and recycled to the process of producing hydroxide.[16]

Penn-Dixie Cement Corp. produced limestone at its Speers Ferry quarry for consumption at its cement plant near Kingsport, Tenn. Limestone was quarried by Blountville Construction Co. at its Tri-State Lime operation for concrete aggregate and road construction material, agstone, filler in fertilizers, and for filtration purposes. Limestone also was quarried and crushed at Glenita near Clinchport by Natural Tunnel Stone Co. for use in concrete aggregate and road construction and for railroad ballast.

Bituminous coal was mined from four underground operations (three in 1960). Output was larger than in 1960. The principal producer was Rye Cove Coal Co., and the most productive coal seam was the Stock Creek.

A natural gas well test near Fairview in the Valley and Ridge Province was abandoned at a depth of 1,400 feet, and the rig was moved to a new location about 1 mile south of Duffield. Both sites were in folded Paleozoic rocks.

Shenandoah.—Limestone used chiefly in the manufacture of lime and for metallurgical flux was produced by Dominion Division of Chemstone Corp., near Strasburg. Quicklime and hydrated lime, chiefly for chemical uses, was produced by the firm's four gas-fired shaft kilns and continuous hydrators. Shipments of finished material were chiefly to Pennsylvania and Ohio. High-calcium limestone for flux in blast furnaces and open-hearth plants and for cement manufacture was quarried by Shenandoah Valley Lime & Stone Corp. at its Strasburg plant. C. S. Mundy Quarries, Inc., N. K. Kipps, and Toms Brook Lime & Stone Co., Inc., crushed limestone for use as concrete aggregate, for road construction, and for agricultural purposes at plants near Forestville, Mt. Jackson, and Toms Brook, respectively.

Smyth.—Limestone was produced by Organic Chemical Division of Olin-Mathieson Chemical Corp. at its Worthy mine chiefly for use in manufacturing lime at the company plant near Saltville. The lime plant consisted of 3 rotary and 14 vertical coal and coke-fired kilns.

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[16] Mining World. How Foote Mineral Cuts Stack Loss With Electrostatic Precipitators. V. 23, No. 12, November 1961, p. 38.

Brine pumped from its own salt wells and quicklime produced at the lime plant were used to manufacture chlorine, soda ash, and other chemicals.

E. P. Ellis and Holston River Quarry, Inc., both with quarries near Marion, and Cardinal Construction Co., near Chilhowie, produced limestone for use as concrete aggregate and roadstone. Rockydale Hardrock Co. went out of business. C. R. Snider & Sons Sand Co. and Sayers Sand Co. produced building sand near Marion. Sayers Sand Co. also produced gravel for road construction. Sugar Grove Sand & Lime Co., Sugar Grove produced building sand.

Appalachian Shale Products Co. mined shale near Marion for use in manufacturing building brick. Output was slightly less than in 1960.

A large new underground gypsum mine, the Locust Cove mine, was developed about 18 miles from Saltville, during the latter part of 1961 by United States Gypsum Co. and was expected to be in production early in 1962.

Spotsylvania.—Fredericksburg Stone Co. produced concrete aggregate, roadstone, and railroad ballast at a granite quarry near Fredericksburg. Production was substantially greater than in 1960. Washed and screened building and paving sand and gravel was produced near Fredericksburg by Massaponax Sand & Gravel Corp.

Stafford.—Diamond Construction Co., Jobe Newton, and Dominion Sand & Gravel Corp. produced sand and gravel for building purposes and for fill.

Surry.—Building and paving sand and gravel were produced at its Hatch plant by Friend Sand & Gravel Co., Inc.

Tazewell.—Output of bituminous coal dropped 47 percent. Tazewell County ranked fifth among coal-producing counties. The number of active mines was 30 compared with 37 in 1960. Of those active in 1961, 22 were underground, 2 were strip, and 6 were auger mines. Most of the tonnage was produced at underground mines. The equipment used underground included 36 handheld and postmounted drills, 5 rock drills, 37 locomotives, 472 mine cars, 18 shuttle cars, 19 shuttle buggies, and 27 cutting machines. Three diesel-powered shovels, three under-3-cubic-yard carryall scrapers, and four bulldozers were used in strip mining; seven augers, one diesel-powered shovel, six bulldozers, and five trucks or tractor-trailers were used in auger mines. The chief coal producers included Bishop Coal Co., Pocahontas Fuel Co., Southeastern Mining Co., and Alfredton Coal Co. The principal seams mined were the Upper Seaboard, No. 3, No. 5, Red Ash, and the Jawbone.

Crushed limestone was produced by Pounding Mill Quarry Co. at its two quarries at Bluefield and Pounding Mill, chiefly for concrete aggregate and roadstone. Limestone also was quarried by Peery Lime Co., Inc., North Tazewell, and Blue Glass Lime Co., Maxwell, chiefly for use in their own limekilns. Hydrated lime, produced in coal-fired pot kilns and batch and continuous hydrators, was used for masonry and agricultural purposes. Virginia operations consumed a large portion of this lime. Shipments also were made to North Carolina, Tennessee, and West Virginia.

General Shale Products Corp. mined shale at an open pit near Richland for use in manufacturing building brick.

The first successful natural gas well in the county was completed by United Fuel Gas Co. during the year. The well was drilled to the Berea formation to a total depth of 5,145 feet.

Warren.—A shaley limestone was quarried by Riverton Lime & Stone Co., Division of Chadbourn Gotham, Inc., for use in making masonry cement. The finished product was shipped mostly to Virginia, North Carolina, and the District of Columbia. Limestone for concrete aggregate and roadstone was quarried by Skyline Crushed Stone Co., near Front Royal, and Riverton Lime & Stone Co., Riverton. The latter firm also produced agricultural stone.

Washington.—Limestone for building and highway construction and for agricultural stone was quarried by Lambert Bros., Inc., Division of Vulcan Materials Co. at Abingdon and Bristol, and by Meadowview Lime Co., Meadowview. Washington County Stone Co., also at Meadowview, produced crushed limestone for concrete aggregate and roadstone.

The only producing gypsum mine in the State in 1961 was the United States Gypsum Co., operating at Plasterco. Plasterboard and other gypsum products were manufactured at the nearby Plasterco mill.

Westmoreland.—Potomac Sand & Gravel Co. produced paving sand and gravel at its stationary plant near Kinsale.

Wise.—Production of bituminous coal increased 39 percent, but the county continued as the third largest coal-producing county, tonnagewise. The value, however, nearly matched that of Dickinson County, the second highest producing county. The number of active mines totaled 236, of which 205 were underground mines, 22 were strip mines, and 9 were auger mines. Over four-fifths of the tonnage was produced from underground mines, and about 15 percent was obtained from strip mines. Output of strip coal increased slightly to 1.1 million tons. Wise County ranked first in production of strip-mined coal. Underground equipment included 288 handheld and postmounted drills and 112 rock drills, 206 locomotives, 35 rubber-tired tractors, 1,388 mine cars, 83 shuttle cars, 68 main conveyors, and 182 cutting machines. Miles of main-line haulage totaled 43.9 and other haulage, 12.4 miles. Equipment used at strip mines included 4 diesel-electric and 39 diesel-power shovels, one 3-to-5-cubic-yard and 42 under 3-cubic-yard-capacity carryall scrapers, 37 bulldozers, 11 horizontal and 4 vertical power drills, and 47 trucks or tractor-trailers. Equipment used in the nine auger mines included nine augers, nine bulldozers, and two power drills. Chief coal producers included United States Steel Corp., Stonega Coke & Coal Co., Stamack Mining Co., Wise Coal & Coke Co., and Coal Processing Co. The principal coal seams mined were Clintwood, High Splint, Upper Banner, Blair, and Imboden. Sizable quantities of coal also came from the Norton, Kelly, and Taggart seams. Less than 4 months after a disastrous fire at the Virginia Iron Coal & Coke Co. coal preparation plant at Virginia City, a new plant was ready for full-scale operation. While construction was underway, a third loading track was added, and a new scale was erected to handle incoming and outgoing traffic simultaneously. A detailed description of the plant operation and the various sizes of coal prepared was given.[17]

Wise County was the only coke-producing county in the State, and the following five companies produced beehive coke—Christie Coal & Coke Co., Hawthorne Coke & Mining Co., Stonega Coke & Coal Co., Norton Coal Co., and Wise Coal & Coke Co. No slot-type ovens were operated, and no byproducts were recovered.

Southwest Quarries, Inc., quarried and prepared limestone for concrete aggregate and roadstone near Big Stone Gap.

One natural gas well was completed by Clinchfield Coal Co. to a total depth of 5,367 feet to the Devonian shale formation.

Wythe.—New Jersey Zinc Co., Bertha Minerals Division, produced recoverable lead and zinc at the Austinville mill, which operated at full capacity for the entire year. Room and pillar mining was used. A record tonnage of zinc was recovered. Ore from both the Ivanhoe and the Austinville mines was concentrated at the Austinville mill. Progress on development of the 11th level of the Austinville mine to open a new ore body continued at a reduced pace, because of water problems. Zinc concentrate was treated at smelters at Palmerton, Pa. (New Jersey Zinc Co.) and East Chicago, Ind. (Grasseli Chemicals Department, E. I. du Pont de Nemours & Co. Inc.). Lead concentrate was shipped for metal recovery to the Carteret, N.J., smelter of American Smelting and Refining Co., and to Japan. No byproduct silver was reported in 1961.

H. D. Crowder & Sons, near Austinville, and Pendleton Construction Corp., near Wytheville, produced crushed limestone for use as concrete aggregate and roadstone and for cement manufacture. A large quantity of finely divided limestone was recovered from the lead and zinc operations of New Jersey Zinc Co. at Austinville and sold chiefly as agricultural stone. Building sand was produced by Silica Products Co. at its Max Meadows stationary plant.

York.—Southern Materials Co., Inc., produced sand near Yorktown for building and paving use.

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[17] Coal Age, v. 67, No. 1, January 1962, pp. 115–117.

The Mineral Industry of Washington

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior and the Washington Division of Mines and Geology.

By Frank B. Fulkerson,[1] Jerry J. Gray,[2] and William N. Hale[3]

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WASHINGTON'S mineral production was valued at $73 million in 1961 compared with $70.5 million in 1960. The apparent increase of $2.5 million in the State value was due entirely to the inclusion for the first time of the value of lime recycled at pulp mills. In 1961 seven pulp mills recycled lime worth $8.5 million. Except for this extension of the statistical coverage, the value of mineral production in Washington would have declined $6 million as a result of decreased production of sand and gravel, stone, and cement, which were three of the major commodities. Other principal commodities were lead, zinc, uranium, gold, and coal. Lead output gained, but the value was less, owing to lower prices. Uranium production was greater, while zinc and gold output declined. Coal production continued a long-term decline.

Increased use in highway construction and road maintenance was not enough to offset lower demand at U.S. Army Corps of Engineers projects and as a result Government-and-contractor sand and gravel production decreased 49 percent. Commercial sand and gravel output advanced 4 percent.

Lower demand by the steel industry in the eastern United States caused a decrease in magnesite production in Washington.

A contract with the U.S. Atomic Energy Commission (AEC) to furnish 120,000 tons of coal to the Hanford Atomic Works during fiscal year 1962 prevented closure of the Roslyn mine of Northern Pacific Railway Co., Kittitas County. At the Roslyn No. 9 mine, the Federal Bureau of Mines carried out test mining with a high-pressure jet of water under an agreement with the company.

Oil exploration continued, particularly in Grays Harbor County. The Medina No. 1, drilled in 1957 by Sunshine Mining Co. near Ocean City, Grays Harbor County, was the only crude-oil producer in the State.

Primary aluminum production in 1961 was 331,264 tons valued at $168.9 million. This tonnage was 69 percent of the rated capacity of

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[3] Geologist, Bureau of Mines, Albany, Oreg.

TABLE 1.—Mineral production in Washington[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite short tons	(2)	(2)	5, 100	$42
Clays[3] thousand short tons	169	$163	145	138
Coal (bituminous) do	228	1, 721	191	1, 381
Copper (recoverable content of ores, etc.) short tons	78	50	66	40
Lead (recoverable content of ores, etc.) do	7, 725	1, 808	8, 053	1, 659
Lime[4] thousand short tons	------------	------------	349	8, 481
Peat short tons	27, 770	121	55, 543	359
Petroleum (crude) thousand 42-gallon barrels	1	(2)	(2)	(2)
Sand and gravel thousand short tons	[5] 25, 594	[5] 19, 459	18, 994	16, 145
Stone do	13, 897	15, 796	11, 464	14, 758
Talc and soapstone short tons	2, 406	12	2, 927	23
Uranium ore do	171, 255	3, 223	175, 327	3, 582
Zinc (recoverable content of ores, etc.) do	21, 317	5, 500	20, 217	4, 650
Value of items that cannot be disclosed: Abrasive stone (grinding pebbles), carbon dioxide, cement, diatomite, epsomite (1961), gem stones, gold, gypsum, magnesite, olivine, pumice, silver, tungsten (1961), and values indicated by footnote 2	------------	24, 552	------------	23, 666
Total[6]	------------	[5] 70, 485	------------	73, 006

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Excludes fire clay; included with "Value of items that cannot be disclosed."

[4] Excludes lime produced from limestone; included with "Value of items that cannot be disclosed."

[5] Revised figure.

[6] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

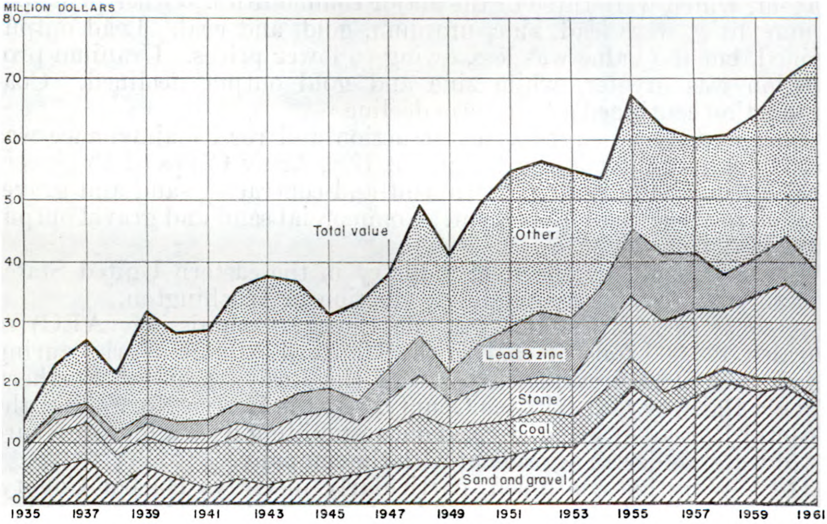

FIGURE 1.—Value of sand and gravel, coal, stone, lead and zinc, and total value of mineral production in Washington 1935–61.

the State aluminum industry compared with 72 percent in 1960. Conditions were improving by the end of the year with the declining production trend apparently reversed.

The mineral production index was 97 compared with 110 in 1960 (1959=100). The index was an average of the increases and decreases in the quantities (tons, barrels, ounces, etc.) produced, weighted by the 1961 values, compared with the base year 1959.

Consumption, Trade, and Markets.—The value of highway contract work performed dropped $4.3 million; highway contracts awarded also decreased in value. Cement shipments from all sources to Washington destinations, an indicator of overall construction activity, were 2 percent lower, probably reflecting the completion of some large engineering projects. The value of building permits issued in the principal cities rose $43.5 million, indicating an increase in commercial and residential building. Employment in the construction industry gained slightly owing to greater employment in King County, particularly at the Seattle World Fair site.

TABLE 2.—Indicators of Washington business activity

	1960	1961 [1]	Change, percent
Personal income:			
Total ... million dollars	6,626.0	6,908.0	+4
Per capita ... dollars	2,317.0	2,380.0	+3
Construction activity:			
Building permits ... million dollars	325.6	369.1	+13
Heavy engineering awards ... do	221.1	175.5	−21
State highway commissions:			
Value of contracts awarded ... do	68.3	66.9	−2
Value of contract work performed ... do	54.7	50.4	−8
Cement shipments to and within Washington thousand 376-pound barrels	5,643.0	5,506.4	−2
Cash receipts from farm marketing ... million dollars	574.2	548.9	−4
Factory payrolls ... do	1,286.9	1,355.0	+5
Annual average labor force and employment:			
Total labor force ... thousands	1,089.9	1,096.4	+1
Unemployment ... do	69.4	74.3	+7
Employment:			
Construction ... do	44.6	44.9	+1
Aircraft ... do	57.8	62.2	+8
Lumber and wood products ... do	44.4	41.3	−7
Food processing ... do	27.1	26.8	−1
All manufacturing ... do	216.6	217.2	0
All industries ... do	1,020.3	1,021.6	0

[1] Preliminary figures.

Sources: Survey of Current Business, Construction Review, Pacific Builder and Engineer, Washington State Highway Commission, The Farm Income Situation, Washington Employment Security Department, and Bureau of Mines.

Per capita personal income was up 3 percent over 1960, a slightly larger gain than the national increase. Larger factory payrolls, particularly in the aircraft industry in the Seattle area, provided most of the lift and more than offset declining farm income.

Employment and Injuries.—Employment in the mining industry increased 3 percent, according to the Washington Employment Security Department. Employment in smelting, refining, and casting (mainly aluminum, copper, and steel) dropped 8 percent because of adverse market conditions and foreign competition. The number of workers in stone, clay, and glass products industries decreased 2 percent.

TABLE 3.—Annual employment and total wages in the mineral industries

Industry	1960		1961	
	Employment	Wages (thousands)	Employment	Wages (thousands)
Mining:				
Metal mining	609	$3,935	616	$4,045
Bituminous coal, crude petroleum, and natural gas	258	1,536	251	1,558
Nonmetallic mining and quarrying	909	5,649	962	6,108
Total	1,776	11,120	1,829	11,711
Stone, clay and glass products:				
Cement, hydraulic	659	4,040	549	3,535
Structural clay products	326	1,802	294	1,626
Concrete, gypsum and plaster products	3,233	19,299	3,306	20,474
Other	767	4,512	746	4,516
Total	4,985	29,653	4,895	30,151
Smelting, refining, and casting:				
Blast furnaces, steel works rolling and finishing mills	2,025	13,076	1,836	12,133
Iron and steel foundries	999	5,886	905	5,337
Smelting, refining, and casting of nonferrous metals, except aluminum	1,164	6,634	956	5,589
Smelting, rolling, drawing, and casting of aluminum	5,940	40,641	5,660	40,623
Miscellaneous	49	323	49	318
Total	10,177	66,560	9,406	64,000
Industrial chemicals [1]	8,754	68,591	9,002	75,983
Petroleum refining and related industries	1,443	9,556	1,352	9,572
Grand total	27,135	185,480	26,484	191,417

[1] The Hanford atomic plant is the largest in this classification.

Source: Washington Employment Security Department bulletins on industries covered by Washington State Employment Security Act. Industry groups may vary from those in the Bureau of Mines canvass.

TABLE 4.—Injury experience in the mineral industries

Year and industry	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1960:						
Quarries and mills [1]	828	217	1,439,642	1	8	6
Nonmetal mines and mills	284	148	341,896	----------	16	47
Sand and gravel operations	758	197	1,195,550	----------	22	18
Metal mines and mills	495	236	938,000	----------	39	42
Coal mines	194	183	283,563	1	23	85
Total	2,559	205	4,198,651	2	108	26
1961: [2]						
Quarries and mills [1]	872	214	1,501,345	----------	20	13
Nonmetal mines and mills	194	164	264,087	----------	2	8
Sand and gravel operations	758	188	1,173,454	----------	23	20
Metal mines and mills	458	260	951,815	1	50	54
Coal mines	192	175	262,317	----------	24	91
Total	2,474	208	4,153,018	1	119	29

[1] Includes cement- and lime-processing plants.
[2] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Manufacturers Mineral Co., Chewelah, Stevens County, produced a small quantity of silica grinding pebbles for use at its Seattle plant. The Carborundum Co., Vancouver, manufactured silicon carbide for abrasive and refractory purposes. A new company, Saco, Inc., began producing silichrome abrasives from a ferrochromium reject product obtained from Pacific Northwest Alloys, Inc., at Mead near Spokane.

Barite.—Production of crude barite increased sharply over 1960. Output was from eight operations—seven in Stevens County and one in Pend Oreille County. Triton Mining Co., the largest producer, mined barite from the Cardinal, Uribe, and Wells Fargo properties in Stevens County. Production also was reported from the Stevens County Lynx Cats (D. & P. Lewis Mining Co.), Allan (Hyram Davis), Madsen (W. A. Madsen), and Flagstaff Mountain (Leonard & Bob Sell) deposits. A pit near Usk, Pend Oreille County, operated by F. W. Bailor, supplied a portion of the output. Barite was ground at the Northwest Talc & Magnesium Co. grinding plant at Clear Lake, Skagit County, and sold to Kelbar Co., Tacoma.

Cement.—Combined output of portland and masonry cement declined 3 percent and shipments were 6 percent less than in 1960.

Production from six plants, operated by four companies, was about 64 percent of capacity (66 percent in 1960). Yearend stocks were slightly higher than for the previous year.

Shipments of portland and masonry cement terminated mainly within the State (92 percent); out-of-State shipments were made to Idaho (4 percent), Alaska (2 percent), Montana (1 percent), Oregon (about 1 percent), and foreign countries (less than 1 percent). Portland cement shipments were distributed as follows: 66 percent to ready-mixed concrete companies; 13 percent to concrete product manufacturers; 8 percent to building material dealers; 7 percent to general contractors; 3 percent to highway contractors; and 3 percent to Federal, State, and local government agencies. Of the total portland cement shipped, 53 percent was transported by truck, 45 percent by rail, and 2 percent by boat. The ratio of bulk to container (paper bag) shipments was about 7:1.

Nine cement plants in Washington and Oregon produced 7,412,700 barrels of finished portland cement; shipments from the same plants totaled 7,385,700 barrels. The average value of portland cement shipped by Oregon and Washington producers remained at $3.52 per barrel, f.o.b. plant.

Clays.—The quantity of clays sold or used by producers declined 16 percent, mostly because of reduced output of miscellaneous clay for heavy clay products (building brick and draintile). Less clay used in cement manufacturing and lower output of fire clay, used in making refractory products, also contributed to the decline.

Fire clay was mined at operations in King and Spokane Counties. Miscellaneous clay for making heavy clay products was furnished from 12 pits in 7 counties. King, Spokane, and Whatcom Counties with one pit each were the sources of clay used in manufacturing cement. A small quantity of bentonite, used for lining irrigation canals, was dug in Yakima County.

Diatomite.—Production of diatomite increased 15 percent over 1960. The sole producer, Kenite Corp., Quincy, Grant County, marketed prepared diatomite for filler, insulation, and miscellaneous purposes.

Gypsum.—A mixture of gypsum, quartz, and clay (gypsite) was mined from the Poison Lake deposit near Tonasket, Okanogan County. The gypsum product was marketed for agricultural purposes.

Crude gypsum, shipped from Baja California, Mexico, was processed for use in building products by Kaiser Gypsum Co., Inc., Seattle. Greenacres Gypsum Co., Inc., Spokane, marketed gypsum imported from Canada for agricultural use.

Lime.—Limestone was calcined to lime for use in sugar refining at two Utah-Idaho Sugar Company refineries; quicklime was utilized at a Grant County plant, and hydrated lime was used at a Yakima County refinery.

Lime recycled at paper mills was included in the value of State mineral production for the first time. Seven pulp mills yielded 349,247 short tons of recycled lime valued at $8.5 million. From 2 to 5 percent of the recycled material was original lime (make-up lime). Limestone processed to quicklime or hydrated lime in paper company kilns was negligible; most of the lime used as make-up lime was purchased from lime producing companies.

Magnesian Minerals.—Output of crude magnesite from the Red Marble quarry, Stevens County, by Northwest Magnesite Co. was about 8 percent less than in 1960. Lower demand for refractory magnesia by the steel industry was the major cause of the decline.

Production of olivine by Northwest Olivine Co. from the Twin Sisters quarry, Skagit County, nearly doubled. Crude olivine was processed by the company at a plant near Hamilton, and the finished material was sold mainly for use as foundry sand.

Agro Minerals, Inc., recovered epsomite (hydrous magnesium sulfate) from the Poison Lake deposit, Okanogan County. Epsomite, used as an ingredient in chemical fertilizer, had not been mined from this deposit since 1957.

Pumice.—Output of pumice and pumicite increased 41 percent over 1960. Pumicite, mined in Yakima County, was prepared as pozzolan for use as a concrete admixture. Westone Construction Products Co., Penticton, British Columbia, produced pumice from the Standard mine in Chelan County; the crude product was shipped to British Columbia and used as concrete aggregate. The Sorlie pit, Chelan County, yielded pumice for use as concrete aggregate.

Sand and Gravel.—Output of sand and gravel was 19 million tons valued at $16.1 million—declines of 26 and 17 percent, respectively, below 1960.

Production of sand and gravel by Government-and-contractor firms was 7.5 million tons compared with 14.5 million tons in 1960. The decrease was due largely to smaller requirements for these commodities at U.S. Army Corps of Engineers projects. Demand for sand and gravel for use in highway construction and road maintenance advanced 46 percent over 1960. Of the total Government-and-contractor production, 78 percent was used for road construction and maintenance, 6 percent for building purposes (concrete and mortar, exclusive of road construction), and 16 percent for miscellaneous uses, including fill material.

Commercial sand and gravel production of 11.5 million tons was 4 percent greater than in 1960. Thirty-six percent of the commercial output was consumed in road building and maintenance; 37 percent was used for building purposes (concrete and mortar, exclusive of roads); and 27 percent had miscellaneous applications, such as railroad ballast, fill material, and glass, molding, and blast sands. Sand and gravel was produced in 38 of the 39 counties. Output was valued at over $2 million in both King and Pierce Counties, and more than $1 million each in Snohomish and Spokane Counties.

TABLE 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	[1] 4,832	[1] $4,975	4,250	$4,502
Road material	[1] 3,739	[1] 3,552	4,156	3,871
Fill	1,876	1,154	2,743	1,204
Railroad ballast	359	214	193	109
Other [2]	[1] 239	[1] 405	183	322
Total	[1] 11,046	[1] 10,300	11,526	10,007
Government-and-contractor operations:				
Building	1,781	2,251	422	415
Road material	4,026	3,284	5,858	5,106
Fill	8,394	3,287	1,089	538
Other [2]	348	336	99	79
Total	14,549	9,158	7,468	6,138
All operations:				
Building	[1] 6,613	[1] 7,226	4,672	4,917
Road material	[1] 7,766	[1] 6,836	10,014	8,977
Fill	10,270	4,441	3,832	1,742
Railroad ballast	359	214	193	109
Other [2]	587	741	283	400
Total [3]	[1] 25,594	[1] 19,459	18,994	16,145

[1] Revised figure.
[2] Includes special sands for construction and industrial uses and sand and gravel used for miscellaneous unspecified purposes.
[3] Owing to rounding, individual items may not add to totals shown.

Stone.—Stone was quarried in 35 of the 39 counties, and output totaled 11.5 million tons valued at $14.8 million—declines of 18 and 7 percent, respectively, from 1960. Pacific, Klickitat, King, and Whatcom Counties, in order of ascending output, each had production valued at over $1 million.

Basalt, contributing 9.8 million tons to the total stone output, was used for concrete aggregate, roadstone, riprap, and ballast. Crushed marble (for roofing granules, terrazzo chips, and agricultural purposes) and dimension marble were marketed from Stevens County quarries.

Dimension granite output was from Kitsap, and Spokane, Counties. Crushed granite, from King, Okanogan, Snohomish and Spokane Counties, was used as roadstone, riprap, roofing rock, and poultry grit.

TABLE 6.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1960		1961	
	Quantity	Value	Quantity	Value
Dimension stone (building)	7	$265	8	$281
Concrete and roadstone	6,834	6,743	6,743	7,417
Riprap	1,229	2,003	3,307	4,348
Railroad ballast	(1)	(1)	(1)	(1)
Other [2]	5,828	6,786	1,406	2,712
Total [3]	13,897	15,796	11,464	14,758

[1] Included with "Other" to avoid disclosing individual company confidential data.
[2] Used at cement, paper, metallurgical, and chemical plants; sugar refineries; and for miscellaneous unspecified purposes, and items indicated by footnote 1.
[3] Owing to rounding, individual items may not add to total shown.

Dimension sandstone was quarried in Kittitas, and Pierce Counties, and quartzite flagstone was supplied from a quarry in Ferry County. Sandstone, quartz, and quartzite for use as industrial silica were produced in Pend Oreille, Pierce, Spokane, and Stevens Counties; output was used by the cement, glass, metallurgical, chemical, and aircraft industries.

Talc and Soapstone.—Tonnage and value of soapstone output increased 22 and 92 percent, respectively, over 1960. Three producers Cascade Talc & Silica Co. (Sibley Creek mine), Skagit Talc Products (Skagit Talc mine), and Herman Smith (Boulder Creek mine), were active near Marblemount in Skagit County. Crude material was ground at plants of Manufacturers Mineral Co. (Seattle), Northwest Talc & Magnesium Co. (Clear Lake), and Miller Products Co. and Stauffer Chemical Co. (both in Portland, Oreg.). The ground material was used in insecticides and for paint manufacture.

Vermiculite (Exfoliated).—Crude vermiculite produced in Montana was exfoliated at the Spokane plant of Vermiculite Northwest, Inc. Output of the expanded product remained at about the 1960 rate and was marketed principally for use as insulation and lightweight-plaster and concrete aggregate.

METALS

Cominco Products, Inc., a subsidiary of Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, British Columbia, added a new electronic-materials plant to its existing facilities at Spokane to fabricate high-purity metal sheet, wire, rod, and preforms. The metals to be used were antimony, arsenic, bismuth, cadmium, indium, lead, silver, tin, and zinc. The preforms, which were to account for the largest percentage of sales, were to be manufactured as tiny discs, spheres, squares, rectangles, and washers for use primarily in manufacturing transistors and diodes.

Aluminum.—Production of primary aluminum, the lowest in the past 3 years, was 331,264 tons valued at $168.9 million compared with 346,000 tons valued at $181.1 million in 1960. This was a decrease of 4 percent in tonnage and 7 percent in value.

At the Kaiser Aluminum & Chemical Corp. Mead plant, production was cut sharply at the beginning of the year and by March was down to 38 percent of rated capacity; however, by midyear output recovered to 87 percent of capacity and fluctuated between 87 and 90 percent during the remainder of the year.

Exports of primary aluminum through the Washington Customs District to Asia, Europe, and South America totaled 13,600 tons, which was about the same as in 1960, according to the Bureau of the Census records. The bulk of the shipments went to Japan (5,900 tons) and the United Kingdom (4,100 tons). Aluminum scrap exports (principally to Japan) doubled to 3,000 tons and also moved through the Washington Customs District. Other Washington shipments of aluminum were made through the Oregon Customs District.

TABLE 7.—Primary aluminum plant capacity and production data

Year	Rated primary capacity, short tons	Primary production			Average U.S. ingot price per pound, cents
		Short tons	Percent of national total	Value (thousands)	
1952–56 (average)	419,000	408,544	30	$172,775	22.4
1957	483,000	445,709	27	227,383	27.5
1958	483,000	311,417	20	156,376	26.9
1959	483,000	333,615	17	165,423	26.9
1960	483,000	346,126	17	181,138	[1] 26.0
1961	483,000	331,264	17	168,921	25.5

[1] Price of pig now applied to ingot. The use of the term "pig" was discontinued in August 1960.

Beryllium.—A beryllium exploration program was carried out in Ferry and Stevens Counties by the Federal Bureau of Mines. A mobile spectroscopic laboratory was used to field-test known occurrences of beryl, but no potentially commercial deposit was discovered.

Copper.—Production of copper decreased 15 percent compared with 1960. Over half of the 66-ton primary output was recovered as a byproduct from lead-zinc mining in Pend Oreille County, and much of the remainder came from the Kromona Consolidated Mines, Inc., Kromona mine, Snohomish County, and the Paymaster Mines, Inc., Paymaster mine, Okanogan County.

Secondary copper was recovered from a new dust-collection facility at the Bethlehem Steel Co., Pacific Coast Division, Seattle plant and from a furnace cleanup operation at the United States Gypsum Co. Tacoma plant.

Ferroalloys.—Ferrosilicon and silicon metal were produced by Ohio Ferroalloys Corp., Tacoma, and By Keokuk Electro-Metals Co., Wenatchee, a subsidiary of Vanadium Corporation of America. At Mead, Pacific Northwest Alloys, Inc., produced ferrosilicon and ferrochromium from African chromite concentrate.

Gold.—Output of gold decreased 9 percent below 1960. The principal gold producers were Knob Hill Mines, Inc. (Knob Hill mine and the adjoining Day Mines, Inc., Gold Dollar mine, Ferry County), and the Lovitt Mining Co. (Gold King mine, Chelan County).

According to the Day Mines, Inc. (Wallace, Idaho) annual report, the company and Lovitt Mining Co., Wenatchee, entered into a long-term joint venture for the future operation of the Gold King mine. The venture was to be called L–D Mines. For 30 percent interest in the new company, Day Mines, Inc., provided funds for a 300-ton flotation mill, thus enabling L–D Mines to operate on lower grade ore.

A few ounces of placer gold were produced by three small operations in Clallam, Ferry, and Kittitas Counties.

Lead.—The American Zinc, Lead & Smelting Co. (Mineral Right and Grandview mines, Pend Oreille County), and the Pend Oreille Mines & Metals Co. (Pend Oreille mine, Pend Oreille County), produced the greatest share of the 8,053-ton lead output valued at $1.7 million.

Lucky Joe Mining Co. (Lucky Joe mine, Pend Oreille County), Rare Metals Corporation of America (Red Top mine, Stevens County), and Clayloon Uranium Co., Inc. (Lead Trust mine, Stevens County), produced small quantities of lead.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1952–56 (average)	27	2	1,614	65,821	$2,304	367	$332
1957	19	1	1,495	(3)	(3)	(3)	(3)
1958	14	3	975	(3)	(3)	(3)	(3)
1959	15	1	958	(3)	(3)	(3)	(3)
1960	17	----------	1,070	(3)	(3)	(3)	(3)
1961	15	3	1,103	(3)	(3)	(3)	(3)
1860–1961	----------	----------	(4)	[5] 2,844,331	[5] 78,307	[5] 16,391	[5] 12,333

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1952–56 (average)	3,723	$2,368	10,949	$3,229	26,067	$6,663	$14,896
1957	1,700	1,023	12,734	3,642	24,000	5,568	13,766
1958	52	27	9,020	2,111	18,797	3,835	10,469
1959	49,	30	10,310	2,371	17,111	3,936	10,986
1960	78	50	7,725	1,808	21,317	5,500	12,388
1961	66	40	8,053	1,659	20,217	4,650	10,986
1860–1961	122,000	43,272	216,000	49,571	440,000	99,372	305,202

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, and ore shipped to smelters during calendar year indicated. Because of rounding, individual items may not add to totals shown.

[2] Does not include gravel washed.

[3] Figure withheld to avoid disclosing individual company confidential data.

[4] 1860–1903 data not available; 1904–1961, 31,442,260 short tons.

[5] Excludes 1957–61.

Silver.—Production of silver remained about the same as in 1960. Five gold-silver mining operations yielded 93 percent of the output. As in former years the chief producer was Knob Hill Mines, Inc.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in 1961, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold and gold mill cleanings [2]	6	116,023	(3)	(3)	4,000	--------	--------
Dry silver	3	4,015	--------	(3)	--------	35,900	3,900
Copper, copper cleanup, and copper assay rejects [2]	4	1,479	(3)	(3)	52,000	2,800	100
Lead	3	6	--------	(3)	--------	3,300	--------
Lead-zinc	3	981,646	--------	(3)	76,000	16,064,000	40,430,000
Total "lode" material	15	1,103,169	(3)	(3)	132,000	16,106,000	40,434,000
Gravel (placer operations)	3	(4)	(3)	(3)	--------	--------	--------
Total	18	1,103,169	(3)	(3)	132,000	16,106,000	40,434,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Figure withheld to avoid disclosing individual company confidential data.
[4] 1,781 cubic yards.

(Knob Hill mine and Gold Dollar mine, Ferry County). The silver to gold ratio was 4.96:1.

Seven lead-zinc producers accounted for 7 percent of the total silver output. The silver-lead ratio, with silver in ounces and lead in tons, was 5.45:1.

Steel.—Furnace dust, collected by the Bethlehem Steel Co., Pacific Coast Division at Seattle, was shipped to the Tacoma smelter where secondary copper, lead, silver, and zinc were recovered.

Jay Steel Corp., Seattle, acquired, improved, modernized and began operating a 12-inch merchant-bar steel mill. The mill was constructed by Alaska Steel Mills, Inc., in 1959, but had been idle since the latter part of that year.

According to Department of Commerce information, total imports of steel mill products (such as sheet piling, plates, bars, and barbed wire) were 43,874 tons with 4,145 tons of other iron and steel products (such as wire rope, baling wire, bolts, nuts, and nails). In 1960 total imports were 43,610 and 7,731 tons, respectively.

Tungsten.—Silver Hill Mines, Inc., produced tungsten concentrate late in the year, and made one shipment to Wah Chang Corp. at Glen Cove, N.Y. The Silver Hill open-pit mine and mill are near Spokane.

Development at the Chief Jo Tungsten, Inc. (Okanogan County), scheelite mine and mill, begun in 1956, continued during 1961. There had been no reported production.

Uranium.—As revealed in the Newmont Mining Corp. annual shareholders report, Dawn Mining Co., 51 percent owned by Newmont Mining Corp., processed 175,000 tons of ore at its Ford mill. The ore yielded 870,000 pounds of uranium oxide valued at $3.6 million. The company obtained most of the ore from its Stevens County Midnite mine and adjoining leases. Some ore came from other mines under a custom-milling arrangement.

The AEC bought only about one-half of the Dawn Mining Co. production. This was the result of a change in policy regarding advance fulfillment of delivery quotas. The remainder was stockpiled by the company.

Zinc.—The greater share of the zinc output came from two mining operations in the Metaline district—American Zinc, Lead & Smelting Co. (Grandview and Mineral Right mines) and Pend Oreille Mines & Metals Co. (Pend Oreille mine). Zinc production was 20,217 tons valued at $4.7 million, compared with 21,317 tons valued at $5.5 million in 1960.

MINERAL FUELS

Carbon Dioxide.—Recovery of carbon dioxide from mineral waters in Klickitat County by Gas-Ice Corp. declined 37 percent below 1960. Output was processed and marketed as dry ice. Also, carbon dioxide was marketed in liquid, gas, and solid (dry ice) forms from the company plant at Finley, Benton County, where carbon dioxide was recovered from an ammonia-plant waste product.

Coal (Bituminous).—Ten mines in four counties yielded 190,700 tons of coal, about 37,400 tons less than in 1960. Kittitas County led in coal production, followed in order by King, Thurston, Lewis, and Pierce Counties.

An agreement with AEC to furnish 120,000 tons of coal to the Hanford Atomic Works prevented closure of the Roslyn mines of Northern Pacific Railway Co., Kittitas County. The company also concluded an agreement with the Federal Bureau of Mines to determine the feasibility of mining coal hydraulically. Test mining with a high-pressure jet of water was carried out at the Roslyn No. 9 mine. Other coal operations in the State were Roslyn Cascade Coal Co. (Roslyn No. 4 mine), Kittitas County; Stoker Coal Co. (Tono No. 4 and Martin No. 5 mines), Thurston County; Palmer Coking Coal Co., Inc. (Rogers, Rogers No. 2, and Franklin No. 12 mines), Coal, Inc. (Black Knight mine), and B & R Coal Co. (Newcastle mine), King County; Black Prince Coal Co. (Black Prince mine), Lewis County; and Queen Coal Co. (Carbonado Wingate No. 4 mine), Pierce County. Work at the Mt. Rainier Coal Co. Wilkeson properties, Pierce County, was limited to exploration and test mining. The company announced that a contract for delivery of 800,000 tons of coking coal over a 4-year period was signed with a syndicate of Japanese steelmakers. Washington coal deposits were the subject of an article.[4]

Peat.—Production of peat was 55,500 short tons, double the amount yielded in 1960. Snohomish County led in peat production, followed by King, Kitsap, Thurston, and Pierce Counties.

Petroleum and Natural Gas.—The Medina No. 1, drilled in 1957 by Sunshine Mining Co. near Ocean City, Grays Harbor County, was the only crude oil producer in the State; however, early in 1961 production was suspended at this well.

In May, Sunshine Mining Co. entered into an agreement with Humble Oil & Refining Co. for further exploration and development of Sunshine company leases in Grays Harbor County. Humble, in an attempt to develop an oil show in Sunshine's Rayonier No. 1–A, drilled two wells (B–1 Everett Trust & Savings Bank Executor and the Ollar State No. 1) in close proximity to the Sunshine company well in a northern group of leases. Results were not encouraging and the three wells were plugged and abandoned. Humble then announced a temporary halt to its wildcating and returned the northern block of leases to Sunshine Mining Co. Studies thereafter were confined to a southern block of leases in the vicinity of Ocean City, included in the Sunshine-Humble agreement. It appeared that any drilling emphasis in the southern lease-block would be directed toward the offshore area.

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[4] Biekman, Helen M., Howard D. Grover, and Toni A. M. Dana. Coal Resources of Washington. Bull. 47, 1961.

Sunshine Mining Co., Cascade Natural Gas Co., and Natural Gas Transmission Co., participating jointly, drilled and subsequently abandoned the No. 1 Beach well at 3,115 feet in the Ocean City area. C & D Minerals, Inc., penetrated the lower horizon (4,496 feet) of the extensive basalt plain in eastern Washington while drilling the Explorer No. 1 near Odessa (Lincoln County). The well, at a total depth of 4,682 feet, bottomed in quartz monzonite after passing through more than 100 feet of sediments. This well was drilled in 1960.

The State made available for leasing 155,000 acres in the coastal areas of Grays Harbor, Pacific, Jefferson, and Island Counties; acreage in the hinterlands of Wahkiakum, Cowlitz, Lewis, Benton, and Grant Counties also was included in the lease parcel.

Late in the year it was announced in the Northwest Oil Report that nine oil companies, participating jointly, had contracted for an aerial magnetic survey along the Oregon and Washington coasts. The participating companies were Standard Oil Co. of California, Humble Oil & Refining Co., Mobil Oil Co., Ohio Oil Co., Pan American Petroleum Corp., Phillips Petroleum Corp., Richfield Oil Corp., Superior Oil Co., and Texaco, Inc.

TABLE 10.—Test holes drilled for oil and gas in 1961

Company	Well	Total depth	County
Port Angeles Gas & Oil Co., Inc	W. L. Dilling No. 1	3,009	Clallam.
Do	Sutter No. 1	6,218	Do.
Humble Oil & Refining Co	Everett Trust & Savings Bank Executor and others No. 1.	4,180	Grays Harbor.
Do	Ollar-State No. 1	5,000	Do.
Sunshine Mining Co	Sunshine-Cascade-Natural and others Beach No. 1.	3,115	Do.
A. E. McCroskey Syndicate	Brandt No. 1	3,944	King.
Do	Brandt No. 2	3,411	Do.
Humble Oil & Refining Co	Everett Trust & Savings Bank Trustee No. 1.	3,654	Lewis.
Do	John M. Brown No. 1	4,484	Do.
Do	Rosa Meyer No. 1	4,482	Do.
Delta Gas & Oil Company, Inc	Alt No. 1	1,100±	Lincoln.
Edward J. Carr	Blessing-Siler Community No. 1	7,562	Pierce.
Humble Oil & Refining Co	E. F. E. Willhoite and others No. 1	5,719	Do.

Source: Washington Division of Mines and Geology.

Three pipelines were planned—a 14.4-mile line in Spokane County from the Pacific Gas Transmission Co. line to the vicinity of Spokane; another from the Mobil Oil Co. refinery at Ferndale to the Anacortes refineries of Shell and Texaco; and a third line from Anacortes to Seattle, Tacoma, Olympia, and Portland markets (324 miles). Washington's Olympic Peninsula, west of Puget Sound, would be served by a $6 million natural gas pipeline proposed by El

Paso Natural Gas Co. and Natural Gas Transmission Co. The line, originating at Olympia, would extend north to Bremerton and Port Townsend, and west to Port Angeles.

Increased quantities of gasoline, heating oils, and jet fuel were to result from installation of two hydro-treating units at the Shell Oil Co. Anacortes refinery.

REVIEW BY COUNTIES

Mineral production was reported from 38 of the 39 counties in Washington in 1961. With certain important exceptions, output was principally nonmetals. Only those counties with significant metal and nonmetal production are discussed in the following review.

Asotin County.—Ideal Cement Co. continued drilling at its Lime Point limestone deposit, 30 miles from Clarkston on the Snake River. The company announced that further development of the deposit, considered to be the country's most valuable mineral resource, would be delayed until information was received that the planned Asotin Dam would have locks that would permit barge transportation of limestone downstream to the cement plant site.

Chelan.—Ideal Cement Co. mined limestone from the Soda Springs quarry near Leavenworth; output was shipped for use in cement manufacture at the company Grotto plant in King County.

Clark.—Hidden Brick Co., Vancouver, and Ridgefield Brick & Tile Co., Ridgefield, produced clay for use in making building brick and draintile.

Cowlitz.—The Washington State Department of Conservation, Division of Mines and Geology, announced plans to drill laterite deposits north of the Columbia River in Cowlitz and Wahkiakum Counties, between Cathlamet and Longview. The material, containing hydrated aluminum oxide, possibly could be used as a source of alumina. The Aluminum Company of America made an extensive study of similar deposits in the vicinity of Abernathy Creek and Oak Point some years ago. Reynolds Metals Co. had alumina shipped from Corpus Christi, Tex., for its reduction plants at Longview, and at Troutdale, Oreg., by a new self-unloading ore carrier. The ship carried 14,500 tons and discharged its load directly into railroad hopper cars.

Ferry.—Knob Hill Mines, Inc., operated its Knob Hill mine and the Day Mines, Inc., Gold Dollar mine, continuously through 1961 at approximately the same rate as in the two preceding years, according to the Day Mines, Inc., annual report. Development at the two properties included 3,387 feet of new workings and 16,707 feet of diamond core drilling.

King.—King County, first in total value for nonmetal production, ranked second in respective value for cement, clay, coal, peat, sand and gravel, and stone.

Production of cement declined considerably at the Seattle plant of Lone Star Cement Corp. while the Ideal Cement Co., Grotto plant, operated at an increased rate compared with 1960. Major construction in the cement industry included eight bulk-loading cement bins and work on six concrete bulk-storage silos at the Seattle storage and distribution terminal of Ideal Cement Co.

TABLE 11.—Value of mineral production in Washington, by counties[1]

(Thousand dollars)

County	1960	1961	Minerals produced in 1961 in order of value
Adams	$396	$455	Stone, sand and gravel.
Asotin	(2)	23	Sand and gravel.
Benton	125	179	Stone, sand and gravel.
Chelan	(2)	1,254	Gold, sand and gravel, stone, silver, pumice, copper.
Clallam	88	163	Sand and gravel, stone, gold.
Clark	608	2,306	Recycled lime, stone, sand and gravel, clays.
Cowlitz	371	(2)	Recycled lime, stone, sand and gravel.
Douglas	849	237	Stone, sand and gravel.
Ferry	(2)	(2)	Gold, silver, sand and gravel, stone, copper.
Franklin	1,838	1,508	Stone, sand and gravel.
Garfield	51	118	Do.
Grant	1,043	1,242	Diatomite, stone, lime, sand and gravel.
Grays Harbor	394	389	Sand and gravel, stone, petroleum.
Island	220	47	Sand and gravel.
Jefferson	457	1,023	Recycled lime, stone, sand and gravel.
King	7,805	8,578	Cement, sand and gravel stone, coal, clays, peat.
Kitsap	282	269	Sand and gravel, stone, peat.
Kittitas	1,071	1,002	Coal, stone, sand and gravel, gold, silver.
Klickitat	2,828	1,560	Stone, sand and gravel, carbon dioxide.
Lewis	654	466	Stone, sand and gravel, coal, clays.
Lincoln	484	315	Stone, sand and gravel.
Mason	(2)	17	Sand and gravel, stone.
Okanogan	238	495	Sand and gravel, stone, gypsum, epsomite, silver, copper, gold.
Pacific	171	1,053	Stone, sand and gravel.
Pend Oreille	10,194	8,417	Zinc, lead, cement, stone, sand and gravel, silver, copper, barite.
Pierce	3,290	4,719	Sand and gravel, recycled lime, stone, clays, peat, lead, gold, silver, coal.
San Juan	156	176	Sand and gravel.
Skagit	3,053	2,794	Cement, stone, olivine, sand and gravel, talc, and soapstone.
Skamania	188	160	Stone, sand and gravel.
Snohomish	1,938	3,780	Sand and gravel, stone, recycled lime, peat, clays, copper, gold, silver.
Spokane	3,872	4,481	Cement, sand and gravel, stone, clays, tungsten, uranium.
Stevens	5,093	5,163	Uranium, magnesite, stone, barite, sand and gravel, lead, zinc, gold, silver, and grinding pebbles.
Thurston	267	228	Stone, coal, sand and gravel, peat.
Wahkiakum	----------	(2)	Stone, sand and gravel.
Walla Walla	6,486	1,925	Recycled lime, stone, sand and gravel.
Whatcom	(2)	(2)	Cement, stone, sand and gravel, clays.
Whitman	190	304	Stone, sand and gravel.
Yakima	1,290	1,630	Sand and gravel, stone, pumice, lime, clays.
Undistributed[3]	16,415	18,448	
Total[4]	70,485	73,006	

[1] No production reported in Columbia County.

[2] Figure withheld to avoid disclosure of individual company confidential data; included with "Undistributed."

[3] Includes value of some stone, sand and gravel, and gem stones that cannot be assigned to specific counties and values indicated by footnote 2.

[4] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime—1960 total revised.

Gladding, McBean & Co. produced clay from the Blum and Harris pits for use as refractory material; the company Palmer and Renton pits yielded clay for making clay products, mainly building brick and draintile. Builders Brick Co. mined clay from operations at the Elk and Newcastle pits, for use in manufacturing building brick and draintile. Palmer Coking Coal, Co., Inc., produced clay from the Bagley pit for heavy clay products manufacture. Ideal Cement Co. dug clay at the Grotto pit for use in its cement-making process. Soapstone mined in Skagit County was ground at the Manufacturers Mineral Co. plant in Seattle.

The principal producers of coal were the Rogers, Rogers No. 2, and Franklin No. 12 mines (Palmer Coking Coal Co., Inc.,) and the Newcastle mine (B & R Coal Co.).

Kittitas.—Kittitas County retained its position as the leading source of coal. Output was from the underground Roslyn No. 9 mine of Northern Pacific Railway Co. and the Roslyn No. 4 strip mine of Roslyn Cascade Coal Co.

Okanogan.—Gypsite and epsomite were mined at the Poison Lake deposit by Agro Minerals, Inc.

Dawn Mining Co. obtained an option on the Gold Gulch quartz mining claim and did some exploration work. This copper prospect was 3 miles west of Nespelem on the Colville Indian Reservation. Newmont Mining Corp. stated in its annual report that Dawn Mining Co. initiated outside exploration during the year and several prospects were examined without encountering any mineral deposits of interest.

Pend Oreille.—The principal nonmetal industry continued to be the Metaline Falls plant of Lehigh Portland Cement Co. Production and shipments of cement declined 5 and 36 percent, respectively, below 1960.

In the annual report to stockholders, Pend Oreille Mines & Metals Co. stated that 742,934 tons of ore was mined and milled in 1961, compared with 727,759 tons in 1960. Operating costs were reduced from $3.004 per ton in 1960 to $2.895, and total costs were lowered from $3.254 to $3.129 per ton. The total development cost of 6,503 feet of drifts and raises and 59,807 feet of diamond and long hole percussion drilling was $297,000.

The Bunker Hill Co. (Kellogg, Idaho) annual report stated that Metaline Contact Mines was reorganized in 1961. Properties owned by the Bunker Hill Co, Day Mines, Inc., and the former Metaline Contact Mines were consolidated to expedite exploration, development, and operation. The Bunker Hill Co. owned slightly over 50 percent of the stock. No development was contemplated for 1962.

Pierce.—Sand and gravel production, remaining at about the 1960 rate, was the highest in the State. Nine commercial operators working 10 pits produced 3.5 million tons of sand and gravel valued at $2.4 million; output was used mainly for building purposes (concrete and mortar) and road construction.

Glacier Sand & Gravel Co., Seattle, opened an electronically controlled concrete plant at North Lake. This was the first multiformula, fully automatic plant in the Pacific Northwest and the third in the Nation. Plans were announced by International Glass Industries, Ltd., Vancouver, British Columbia, to build a flat-glass plant in the Tacoma area. Window glass was to be the prime product manufactured.

Dominion Tar & Chemical Co. announced plans to build a $2 million lime plant at Tacoma. Quicklime and hydrated lime were to be processed from limestone barged from the Texada Island (British Columbia) deposit of Ideal Cement Co.

Skagit.—The Lone Star Cement Corp. plant at Concrete was the major mineral industry in the county; output was 27 percent less than in 1960. Value of production nearly doubled for soapstone and more than doubled for olivine; the county was the State's only source of output for these commodities.

Snohomish.—The county was the principal peat-producing area in Washington. Lowell Brick & Tile Co. used locally mined clay to make building brick. Bear Creek Mining Co., a subsidiary of Kennecott Copper Corp., curtailed exploration in the Glacier Peak area because the U.S. Forest Service ruled that mining exploration could not be carried out by helicopter except on the few mining claims already established in the Glacier Peak Wilderness Area.

Spokane.—The county ranked fourth in value of nonmetal mineral output. The Irvin plant of Ideal Cement Co. continued to be the principal nonmetal mineral industry in the county; the company-owned Spokane County clay pit and Stevens County limerock quarry supplied clay and limestone to the operation.

Gladding, McBean & Co. produced fire clay from the Mica pit and Sommer lease; fire clay refractories and other clay products were made at the company Mica plant.

Daybreak Uranium, Inc. (Dahl lease), shipped 696 tons of ore to the Dawn Mining Co. mill at Ford. Evergreen Uranium Exploration (Morning lease) shipped 134 tons to the same mill. New facilities installed at the Kaiser Aluminum & Chemical Corp. plant at Mead for producing 99.99 percent plus aluminum increased superpurity aluminum capacity 55 percent. At Trentwood the company completed a fully automatic facility to process aluminum sheet and coil for the can-manufacturing industry.

Silver Hill Mines, Inc., operated an open-pit tungsten mine and a gravity mill on a 50-ton-a-day basis. The tungsten ore—0.75 to 1 percent tungsten trioxide (WO_3)—was concentrated to 70 percent WO_3.

Stevens.—Magnesite mining at the Red Marble quarry of Northwest Magnesite Co., despite a 4-month shutdown, supplied the largest part of the county nonmetal mineral output value. Northwest Magnesite stated that operational and maintenance costs of its aerial tramway were reduced 83 percent following automation of the system.

Barite, supplied from seven operations, was shipped by railroad to Clear Lake for grinding before shipment to Alaska for use in oil-well drilling mud.

Construction was completed on the Lane Mountain Silica Co. silica-processing plant at Valley. Del Monte Properties Co. and Northwestern Glass Co., principal owners of the silica operation, contracted with Valley Mining & Quarry Co. to mine and truck the rock from a quarry to the plant 10 miles distant.

Goldfield Consoliated Mining Co. ceased development work at the Anderson mine in mid-1961 because of low lead-zinc prices. Plans for construction of a 1,000-ton mill were being held in abeyance. The company took over control of the Schumaker mine from Triton Mining Co. early in 1961 and conducted extensive exploration during the summer. Later in the year control of the mine was returned to Triton Mining Co.

The Bunker Hill Co., Kellogg, Idaho, used geophysical methods and diamond drilling to prospect the Bonanza, Old Dominion, and Clugston Creek claims on which purchase options had been obtained.

Whatcom.—Whatcom County ranked second in value of nonmetal mineral commodities. The Olympic Portland Cement Co., Ltd., plant at Bellingham continued to be the principal mineral industry and was the largest cement producer in the State. The county was first in value of stone production, mainly because of limestone mined by the cement company. An electrostatic dust-precipitation system was installed at the Bellingham plant to remove dust generated in the calcining stage.

Yakima.—Grimes Co. mined pumicite from the Sunnyside quarry. Tietonite Mines, Inc., produced a small quantity of bentonite from a pit near Naches.

The Mineral Industry of West Virginia

This chapter has been prepared under the cooperative agreement for the collection of mineral data except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geologic and Economic Survey.

By James R. Kerr[1] and Jean Pendleton[2]

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THE VALUE of mineral production in West Virginia dropped $33 million, 5 percent below the 1960 figure. Coal production declined 5 percent, and its average value decreased $0.08 to $4.94 per ton. Both the captive and open-market outlets for coal slumped. Production of all other fuels increased, but because of the relative importance of coal in the State's mineral economy (81 percent of total value), these increases did not offset the loss in coal value. Except for sand and gravel, and cement, production of all other mineral industries decreased. The State's roadbuilding program continued at a high rate, as evidenced by increased production of aggregate and roadstone. The failure of the steel industry to regain its vigor helped depress the coal, clays, lime, and fluxing limestone industries.

McDowell, Logan, Wyoming, Marion, Kanawha, Raleigh, and Monongalia Counties led in value of mineral production and coal output.

TABLE 1.—Mineral production in West Virginia[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays, thousand short tons	626	$2,639	475	$2,193
Coal (bituminous), do.	118,944	597,222	113,070	558,525
Natural gas, million cubic feet	208,757	54,694	210,556	57,692
Natural gas liquids:				
Natural gasoline, thousand gallons	23,211	1,513	34,095	2,296
LP gases, do.	329,874	16,527	342,646	17,826
Petroleum (crude), thousand 42-gallon barrels	2,300	9,361	[2] 2,703	[2] 11,190
Salt, thousand short tons	920	3,673	899	3,510
Sand and gravel, do.	4,506	9,802	4,882	10,152
Stone, do.	[3] 8,001	[3] 14,001	7,628	13,244
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, cement, gem stones, and lime		13,195		13,385
Total West Virginia[4]		[5] 720,601		687,903

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Preliminary figure.
[3] Excludes certain stone, included with "Value of items that cannot be disclosed."
[4] Total adjusted to avoid duplicating value of clays and stone used in manufacturing cement and lime.
[5] Revised figure.

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REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Coal production decreased again in 1961, falling 5 percent below the output for 1960. Tonnages of open-market and captive coal decreased 4 and 11 percent, respectively. The metallurgical market for coal fell because of a lower steel output, and the overall coal market slumped because of generally slackened industrial activity. There were 1,646 active mines, 54 less than in 1960. A number of smaller operations went out of business, and some of the larger pits were idled.

Underground tonnage comprised 93 percent of total production; strip, 5 percent; and auger, 2 percent. The average value per ton of coal produced decreased from $5.02 to $4.94, the lowest since 1955. Cost-cutting was accomplished through increased mechanization and a subsequently reduced labor force. Illustrating the decreased employment requirements is the following comparison of 1951 and 1961 employment statistics. In 1951, 111,886 men were employed in the coal mining industry in West Virginia, producing 6.66 tons per man-shift. In 1961, according to preliminary data, 42,900 men were employed, and productivity was 13.4 tons per man-shift.

Of the underground production, 92 percent was loaded mechanically. Continuous mining continued to increase; 21 new machines were put into operation, making a total of 336. All of the new continuous miners loaded directly onto conveyors. Thirty-seven percent of the mechanically loaded output was by continuous mining, compared with 32 percent in 1960. The number of mobile loading machines decreased by 152; the percentage of mobile-loaded coal dropped 5 percent to 61 percent, the second successive year in which it decreased 5 percent. Of the 336 continuous mining machines, 100 loaded onto conveyors and 236 into shuttle cars, and of the 908 mobile loading machines, 77 loaded into mine cars, 110 onto conveyors, and 721 into shuttle cars. The balance of the mechanically loaded tonnage was handled by 297 hand-loaded face conveyors, 29 less than in 1960.

Other equipment at underground mines included 1,706 cutting machines, 2,235 handheld and postmounted drills, 136 mobile drills, 701 rotary drills, and 381 percussion roof-bolting and rock drills.

The following equipment was used at the strip mines: 250 power shovels, 14 draglines, 10 carryall scrapers, 233 bulldozers, 78 horizontal drills, 53 vertical drills, and 499 trucks. The trucks averaged 16 tons in capacity and traveled an average of 7 miles from pit to tipple. At auger mines there were 78 augers, 14 power shovels, 64 bulldozers, 2 horizontal drills, 3 vertical drills, and 128 trucks. The trucks averaged 17 tons in capacity and traveled an average of 7 miles from pit to tipple.

Transportation from the tipple was chiefly by rail or water (94 percent); the balance was by truck (4 percent) and other methods (2 percent).

The number of active cleaning plants dropped by 18 to 152, but 2 percent more of the total output was cleaned (75 percent). Jigs cleaned 39 percent; wet washing, other than jigs, 53 percent; and pneumatic methods, 8 percent. Thirty percent of total output was crushed, and 14 percent was treated. Of the total treated, 85 percent was with oil, 9 percent with a combination of calcium chloride and oil, 4 percent with calcium chloride, and the balance with other material.

According to preliminary data, there were 87 fatal and 4,380 nonfatal injuries in the State's coal mines in 1961; these totals resulted in an injury rate of 1.31 fatal and 65.81 nonfatal injuries per million man-hours. There were 119 fatal and 4,466 nonfatal injuries in 1960. Injury rates in 1960 were 1.52 fatal and 57.23 nonfatal injuries per million man-hours. Total man-hours worked decreased from 78,040,872 in 1960 to 66,560,000, and the average number of men employed decreased from 51,115 to 42,900.

Falls of roof and face was the usual big killer in the State's underground mines; 41 men were killed by falling material in 1961. Fourteen fatalities were caused by haulage accidents, 7 by machinery, 4 by electricity, 3 by gas or dust explosions, and 3 by all other causes. In surface facilities associated with underground mines, four fatalities were caused by haulage, two by electricity, two by machinery, and four by all other methods. In addition, three fatalities occurred at strip mines.

A chemical charcoal processing plant to cost $600,000 was being constructed by Island Creek Coal Co. at its Red Jacket mine in Mingo County. The completion of this project will reactivate the long idle Red Jacket No. 17 mine, which had employed 225 workers. Less than 10 men will be required to operate the automatic charcoal plant. Finished chemical charcoal was to be sold to Union Carbide & Chemical Co. for use as a catalyst in numerous chemical operations.[3]

Representatives of several Japanese steel companies negotiated to lease or buy two coal mines in McDowell County; they planned to export the metallurgical coal to Japan. If negotiations are successful, more such mine leasings would be contemplated.[4]

The Governor planned to ask the next session of the Legislature to give the right of eminent domain to the proposed builders of a coal pipeline to east coast markets. However, until other States enroute had passed similar legislation, the construction of the pipeline would be delayed. Texas Eastern Transmission Corp. and Consolidation Coal Co. had prepared the necessary plans for the coal pipeline.

Coke and Coal Chemicals.—Four oven coke plants, with 617 ovens active produced 2,694,280 tons of coke, 2 percent less than in 1960. Total value of coke produced was $46.6 million; this amount represented an average value of $17.30 per ton, 13 cents per ton less than in 1960. A total of 3,946,872 tons of coal was carbonized, the average yield was 68.3 percent. It required 1.46 tons of coal to produce 1 ton of coke. The average value of the coal carbonized was $7.80 per ton, well below the national average of $9.79. Recovered products at the oven coke plants included 166,870 tons of coke breeze (a yield of 4.23 percent per ton of coal), 44.6 billion cubic feet of coke oven gas, 41,055 tons of ammonium sulfate equivalent, 40,109,523 gallons of coke-oven tar, and 11,676,640 gallons of crude light oil, from which was derived 7,164,535 gallons of benzene, 2,047,665 gallons of toluene, 676,821 gal-

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[3] Coal Age, v. 66, No. 2, February 1961, p. 58.
[4] Mining Journal, v. 256, No. 6557, Apr. 21, 1961, p. 454.

TABLE 2.—Coal (bituminous) production, by counties

(Thousand short tons and thousand dollars)

County	1960		1961	
	Quantity	Value	Quantity	Value
Barbour	3, 280	$14, 067	3, 062	$13, 401
Boone	6, 152	28, 465	5, 196	24, 119
Braxton	235	997	(1)	(1)
Brooke	541	2, 599	523	2, 224
Fayette	4, 642	22, 664	4, 422	20, 688
Gilmer	957	4, 038	1, 009	4, 527
Grant	(1)	(1)	66	228
Greenbrier	852	3, 581	896	3, 358
Hancock	1	6	------------	------------
Harrison	6, 296	27, 719	6, 391	27, 737
Kanawha	9, 378	42, 546	9, 141	39, 783
Lewis	605	2, 023	573	2, 007
Lincoln	25	115	33	109
Logan	16, 378	74, 410	14, 247	62, 952
Marion	9, 020	49, 022	9, 206	49, 295
Mason	440	1, 540	447	1, 498
McDowell	13, 318	87, 923	12, 919	83, 086
Mercer	642	3, 949	847	5, 294
Mineral	81	294	43	151
Mingo	5, 803	29, 504	5, 038	25, 150
Monongalia	6, 901	34, 481	5, 982	29, 165
Nicholas	4, 929	24, 637	4, 922	23, 236
Pocahontas	376	1, 592	239	900
Preston	2, 730	9, 559	2, 589	8, 729
Putnam	66	299	81	353
Raleigh	6, 631	36, 724	6, 597	35, 644
Randolph	1, 213	6, 098	1, 146	5, 004
Taylor	138	521	201	677
Tucker	259	918	194	587
Upshur	1, 093	4, 687	1, 178	5, 228
Wayne	49	229	54	249
Webster	(1)	(1)	820	3, 909
Wyoming	10, 684	57, 430	10, 354	58, 289
Undistributed [2]	5, 229	24, 585	4, 654	20, 948
Total	118, 944	597, 222	113, 070	558, 525

[1] Included with "Undistributed."

[2] Includes data for Clay, Marshall, and Ohio Counties, and counties indicated by footnote 1.

TABLE 3.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1952–56 (average)	137, 374	$690, 763	1959	119, 692	$621, 003
1957	156, 842	875, 587	1960	118, 944	597, 222
1958	119, 468	635, 201	1961	113, 070	558, 525

lons of xylene, and 84,890 gallons of solvent naphtha (crude and refined). The State continued as the leading coking coal area, producing 28,977,965 tons of coking coal, although Pennsylvania provided almost 80 percent of West Virginia's coking coal requirements.

Petroleum and Natural Gas.—Production of petroleum and natural gas increased 18 and 1 percent, respectively. Production of natural gas liquids also increased; output of natural gasoline rose 47 percent, and that of LP gases, 4 percent.

The number of well completions increased by 236 to 1,120. Of these completions, 857 were gas, 118 were petroleum, 126 were dry holes, and 19 were service wells. Total footage drilled was 2,765,677 feet, an average of 2,469 feet per well. Only 8 of the completions were wildcat wells. Most of the wells were drilled by cable-tool rigs; only 20 were drilled with rotary rigs. Most of the well completions were 1,250 to 2,500 feet in depth.[5]

West Virginia continued as one of the leading States in gas storage capacity. Six companies had gas storage facilities at 32 locations. United Fuel Gas Co., with storage chiefly in Kanawha County, had the greatest capacity. Total gas-storage capacity was 376,911,000 million cubic feet.[6]

Leading gas-producing counties were Doddridge, Gilmer, Kanawha, Lewis, Ritchie, and Upshur. Leading petroleum-producing counties were Clay, Doddridge, Gilmer, Lewis, and Ritchie. The number of producing wells at the end of 1961 was estimated as 17,325 for gas and 12,762 for oil. Lewis County led in total well completions with 218, followed by Ritchie, 176, Doddridge, 141, and Gilmer, 122. Drilling depths ranged from 250 to 10,805 feet, compared with 370 to 13,121 feet in 1960.[7]

Interest increased in deep drilling for gas. Phillips Petroleum Co. barged a giant rotary drilling rig, said to be the biggest in the East, from Louisiana up the Ohio and Kanawha Rivers to Charleston. The rig was then trucked to the well site, which was in Marion County, 28 miles south of Morgantown. Plans were to drill a test well to the Cambrian formations at 15,000 feet. This would be the deepest well ever drilled in the State.[8]

According to the American Petroleum Institute and the American Gas Association, reserves on December 31, 1961, were 2,019,002 million cubic feet of natural gas, 50,924,000 barrels of petroleum, and 58,238,000 gallons of natural gas liquids.

NONMETALS

Cement.—Shipments of portland and masonry cements increased slightly. However, the average value per barrel f.o.b. mill was slightly less than in 1960. Finished portland cement was mostly the general-use and moderate-heat type, non-air-entrained, although significant quantities of air-entrained cement also were produced. Shipments, mostly in bulk, were to Maryland, Virginia, the District of Columbia, and western Pennsylvania. Smaller quantities were shipped to other Eastern States. Ready-mixed concrete companies were the chief customers for portland cement. In addition, concrete-product manufacturers, building-material dealers, and highway contractors consumed significant quantities.

Columbia Cement Corp. announced that a cement distribution point would be established at Nitro, W. Va. The new facility was to have three precast concrete silos with a combined capacity of 10,000 barrels. Cement was to be shipped to the storage facility from the company's Zanesville, Ohio, plant.[9]

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[5] Oil and Gas Journal. Review-Forecast, v. 60, No. 5, Jan. 29, 1962.
[6] Oil and Gas Journal, v. 60, No. 20, May 14, 1962, p. 137.
[7] Tucker, R. C. Oil and Gas Developments in West Virginia in 1961.
[8] Oil and Gas Journal, v. 59, No. 32, Aug. 7, 1961, p. 182.
[9] Pit and Quarry, v. 54, No. 1, July 1961, p. 38–a.

Clays.—Production of clays decreased 24 percent. Fire-clay production was off 25 percent, owing to a sharply reduced market for fire brick and block and for use in foundries and steelworks. Output of fire clay for building brick also decreased. Output of miscellaneous clay decreased 23 percent; curtailed building activity was indicated, as less building brick was produced. Lesser quantities also were consumed in cement manufacture.

Fire clay was produced in Hancock County by three operators, and in Kanahwa County by two operators. Miscellaneous clay production was centered in Berkeley County; smaller quantities were produced in Cabell, Lewis, and Mercer Counties.

TABLE 4.—Clays sold or used by producers

Year	Fire clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1952–56 (average)	484, 663	$1, 981, 333	318, 325	$293, 396	802, 988	$2, 274, 729
1957	402, 581	2, 445, 427	304, 952	245, 182	707, 533	2, 690, 609
1958	264, 107	1, 732, 634	245, 699	227, 340	509, 806	1, 959, 974
1959	328, 792	2, 178, 974	266, 932	312, 970	595, 724	2, 491, 944
1960	346, 053	2, 328, 865	279, 570	310, 341	625, 623	2, 639, 206
1961	259, 340	1, 964, 265	215, 497	228, 531	474, 837	2, 192, 796

Gem Stones.—Cave onyx was collected near Keyser. Other miscellaneous gem materials were collected, chiefly by hobbyists, at scattered locations throughout the State.

Lime.—Production of lime decreased 9 percent; this decline was due chiefly to a decrease in output for refractory uses (dead-burned dolomite) because of a decreased market in the steel industry. Lime production for chemical and agricultural uses increased slightly, and lime production for construction was virtually the same as in 1960. Two producers operated in Berkeley County, and one operated in Jefferson County.

Natural Salines.—Production of bromine compounds decreased significantly from the 1960 output. Ethylene dibromide was the only bromine compound produced; there was no output of bromine or other bromine compounds as in 1960. Less than one-half of the 1960 output of calcium magnesium chloride was produced. The material was recovered from well brines at South Charleston.

Salt.—Output of salt decreased 2 percent. Production, which was used chiefly in brine for chlorine manufacture, was by one operator in Kanawha County and by two operators in Marshall County. Evaporated salt was produced by the open-pan method by one operator in Mason County for sale primarily to feed mixers and feed dealers.

Sand and Gravel.—After declining for 3 successive years, sand and gravel production increased 8 percent. Production of building sand and gravel increased 12 percent and comprised 54 percent of the total output. Paving uses, which comprised 21 percent of output, increased 29 percent. Important quantities of glass sand and ground sand also were produced. Sand comprised 65 percent of total output and gravel the remainder. The average value per ton decreased 10 cents to \$2.08. Twenty-four commercial operators were active in 15 counties. No production of Government-and-contractor sand and gravel was reported. Hancock County led in production of sand and gravel, followed by Morgan, Wood, Pleasants, Cabell, and Brooke Counties. Morgan County, with its valuable glass sand deposits, led in value of production.

An article outlining the State's program for surveying its aggregate resources was published.[10] The objective of the survey was to compile a comprehensive inventory of sources of highway aggregate.

TABLE 5.—Sand and gravel sold or used by producers, by classes of operations and by uses

Class of operation and use	1960		1961	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Building	1, 254, 507	\$1, 475, 835	1, 362, 004	\$1, 671, 464
Paving	380, 538	574, 109	586, 402	846, 515
Fire or furnace	29, 196	33, 575	31, 032	35, 687
Engine	117, 827	328, 228	98, 353	275, 600
Gravel:				
Building	1, 116, 174	1, 287, 348	1, 290, 461	1, 428, 268
Paving	313, 690	519, 188	423, 870	643, 111
Railroad ballast	(1)	(1)	4, 738	6, 396
Fill	7, 104	12, 397	1, 746	2, 297
Undistributed [2]	1, 194, 362	5, 481, 000	1, 082, 984	5, 242, 476
Government-and-contractor operations:				
Gravel:				
Fill	1, 350	500		
Paving	91, 400	90, 280		
Total sand and gravel	4, 506, 148	9, 802, 460	4, 881, 590	10, 151, 814

[1] Included with "Undistributed."
[2] Includes blast, glass, molding, ground, and other sands, railroad-ballast gravel (1960), and other gravel.

Stone.—Production of stone decreased 5 percent, chiefly owing to a 34-percent drop in output of crushed limestone for use as flux in the steel industry. However, roadbuilding continued at a high level, and combined output of crushed sandstone and limestone for concrete aggregate and roadstone increased 5 percent over the previous record set in 1960. Other markets for limestone were cement manufacture, railroad ballast, lime manufacture, and stone sand. Most of the sandstone was used as concrete aggregate and roadstone; small quantities were for refractory use. Stone was produced in 29 counties. The leading counties were Jefferson, Berkeley, Monongalia, and Greenbrier; all produced more than 1 million tons. The State Road Commissioner produced crushed sandstone and crushed limestone for road construction at scattered locations.

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[10] Rock Products. West Virginia Sizes up the Aggregates Situation, v. 64, No. 8, August 1961, pp. 96–98.

TABLE 6.—Stone sold or used by producers, by uses

Use	1960		1961	
	Short tons	Value	Short tons	Value
Crushed and broken stone:				
Flux	2,231,617	$4,164,780	1,479,548	$2,818,445
Concrete and roadstone	3,711,942	6,003,084	3,918,099	6,359,469
Railroad ballast	(1)	(1)	500,970	700,285
Agriculture	87,374	223,742	(1)	(1)
Other [2]	314,777	919,085	334,628	883,449
Undistributed [3]	1,655,348	2,689,957	1,390,794	2,418,623
Dimension sandstone	(1)	(1)	4,335	64,134
Total	8,001,058	14,000,648	7,628,374	13,244,405

[1] Figure withheld to avoid disclosing individual company confidential data.
[2] Includes limestone for miscellaneous uses (asphalt filler, coal dust, glass sand, and stone sand).
[3] Includes limestone for cement and lime, riprap, agriculture (1961), railroad ballast (1960), and refractory sandstone.

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. continued operation of its four-potline primary aluminum plant at Ravenswood. The Fairmont Aluminum Co. completed a $7 million addition to the aluminum rolling facilities at its Fairmont plant. The company, a subsidiary of the Cerro Corp., increased its annual rolling capacity for aluminum sheet from 12,500 tons to 33,000 tons.[11]

Ferroalloys.—Union Carbide Metals Co. and Vanadium Corp. of America produced a wide variety of ferroalloys at Alloy and Graham, respectively. Alloys produced included ferromanganese, ferrosilicon, ferrochromium, silicomanganese, and ferrochromium silicon.

Iron and Steel.—The Weirton Steel Division of National Steel Corp. announced the proposed installation of the first facilities built especially for making "thin-thin" tinplate. The addition at Weirton would triple the company's capacity for producing tinplate. The company also announced it had relighted its rebuilt and enlarged No. 4 blast furnace. As a result, this plant had all four of its ironmaking blast furnaces in operation. The company also announced an effort to curtain the flow of smoke and fume from its oxygen-lance steelmaking furnaces by injecting water into the oxygen being blown into the molten metal. Apparently the water injection helped to reduce smoke from two of the company's largest open hearths.

Nickel.—A major expansion of nickel and nickel-alloy tubing production capacity at Huntington was completed by The International Nickel Co., Inc.[12]

Zinc.—Matthiessen & Hegeler Zinc Co. operated a vertical-retort zinc smelter at Meadowbrook.

Zirconium.—Carborundum Metals Co., Inc., produced zirconium sponge from Florida zircon at a plant in Wood County.

REVIEW BY COUNTIES

Barbour.—Coal output dropped 6 percent, as the number of mines decreased from 66 to 60. As in 1960, 74 percent of the coal was mined from undergound mines, 23 percent from strip mines, and 3 percent from auger mines. West Junior Coal Co. purchased Lipscomb Coal Co. in June and installed a continuous miner. This purchase increased the county's continuous miners to six. Coal mined underground was loaded 23 percent by the 6 continuous miners, 60 percent by 28 mobile loaders, and 17 percent by hand. Gage Coal Co., Inc., opened a new heavy-medium cleaning plant; the percentage of coal cleaned, however, remained at 42 percent. Clinchfield Coal Co. opened the new Compass E mine in May and closed the Compass C mine in September.

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[11] American Metal Market, v. 68, No. 193, Oct. 6, 1961, p. 20.
[12] American Metal Market, v. 68, No. 21, June 26, 1961, p. 1.

TABLE 7.—Value of mineral production in West Virginia, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value[2]
Barbour	(3)	(3)	Coal, stone.
Berkeley	$13,201,040	$12,060,806	Cement, stone, lime, clays.
Boone	28,464,570	24,118,922	Coal.
Braxton	996,489	(3)	Do.
Brooke	2,653,998	2,685,694	Coal, sand and gravel, stone.
Cabell	(3)	(3)	Sand and gravel, stone, clays.
Clay	(3)	(3)	Coal.
Doddridge	----------	(3)	Stone.
Fayette	22,663,682	20,688,037	Coal.
Gilmer	4,084,911	4,527,082	Do.
Grant	(3)	(3)	Coal, stone.
Greenbrier	(3)	140,000	Do.
Hampshire	(3)	(3)	Stone.
Hancock	(3)	(3)	Sand and gravel, clays.
Hardy	13,450	17,924	Stone.
Harrison	(3)	(3)	Coal, stone.
Jackson	46,606	(3)	Stone.
Jefferson	(3)	(3)	Stone, lime.
Kanawha	44,746,934	41,736,386	Coal, salt, stone, clays, bromine, calcium-magnesium chloride.
Lewis	(3)	(3)	Coal, stone, clays.
Lincoln	205,164	127,056	Coal, sand and gravel.
Logan	74,418,020	62,951,574	Coal.
McDowell	87,922,946	83,119,958	Coal, stone.
Marion	49,073,971	49,295,314	Coal.
Marshall	(3)	(3)	Coal, salt.
Mason	(3)	(3)	Coal, salt, sand and gravel.
Mercer	4,052,558	(3)	Coal, stone, clays.
Mineral	(3)	(3)	Stone, coal, gem stones.
Mingo	29,523,832	25,149,718	Coal.
Monongalia	35,567,353	31,083,346	Coal, stone, sand and gravel.
Morgan	(3)	(3)	Sand and gravel.
Nicholas	24,646,076	23,240,194	Coal, stone.
Ohio	(3)	(3)	Coal, sand and gravel.
Pendleton	94,609	(3)	Stone.
Pleasants	(3)	(3)	Sand and gravel.
Pocahontas	1,595,260	(3)	Coal, stone.
Preston	(3)	(3)	Do.
Putnam	299,031	416,025	Do.
Raleigh	(3)	(3)	Coal, stone, sand and gravel.
Randolph	(3)	(3)	Coal, stone.
Roane	48,190	----------	
Taylor	(3)	676,682	Coal.
Tucker	954,982	(3)	Coal, sand and gravel.
Tyler	(3)	(3)	Sand and gravel, stone.
Upshur	4,686,820	5,328,455	Coal, stone.
Wayne	(3)	315,569	Coal, stone, sand and gravel.
Webster	(3)	3,909,351	Coal.
Wetzel	(3)	362,781	Sand and gravel.
Wirt	22,200	----------	
Wood	(3)	(3)	Sand and gravel.
Wyoming	(3)	58,355,854	Coal, stone.
Undistributed	290,618,265	237,596,471	
Total	[4] 720,601,000	687,903,000	

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[1] Calhoun, Ritchie, and Summers Counties are not listed, as no production was reported.

[2] Excludes natural gas, natural gas liquids, petroleum, some gem stones and stone, and some sand and gravel (1961) not assigned to specific counties, included with "Undistributed."

[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[4] Revised figure.

Feather Construction Corp. continued to produce sandstone for road construction at its "Barbour F" plant near Belington.

Berkeley.—Standard Lime & Cement Co., the State's only cement producer, continued operating at Martinsburg. Four kilns were active; two were shut down for repairs. Ready-mixed concrete companies, primarily in Maryland, Virginia, and the District of Columbia, consumed nearly two-thirds of cement output.

Limestone production decreased 36 percent, and the county dropped to second place in limestone output. Output was used chiefly for cement and lime manufacture. Active producers were Standard Lime & Cement Co., Division of Martin Marietta Corp.; Blair Limestone Division of Jones & Laughlin Steel Corp.; and Fry Coal & Stone Co., Division of Martin Marietta Corp. The plant of J. E. Baker Co. was sold in March, and only a small tonnage was mined.

Hydrated lime for masonry mortar and quicklime for agricultural and chemical purposes were produced by Standard Lime & Cement Co. and Jones & Laughlin Steel Corp. Standard Lime & Cement Co. also mined shale for cement manufacture. Miscellaneous clay for building brick was mined by Continental Clay Products Co. and United Clay Products Co.

Boone.—Although 10 additional underground mines were active, production decreased 16 percent, owing to the abandonment of all North American Coal Corp. mines in 1960. The county dropped to tenth place. Westmoreland Coal Co. reopened its Hampton No. 4 mine after a year's idleness. The number of strip and auger mines was unchanged at 5 and 1, respectively; one-tenth of the county's coal output was obtained from these mines. Fifty-one mobile loaders and 17 continuous miners loaded 94 percent of the underground-mined coal. Six cleaning plants prepared 80 percent of the total output.

Braxton.—Coal production decreased 25 percent, as the number of mines dropped from 9 to 5. Guardian Coal Co. used jigs and heavy medium separation at its Lizanne cleaning plant. Ninety-five percent of the underground coal was loaded mechanically by two mobile loaders and one hand-loaded face conveyor.

Brooke.—Five underground, six strip, and one auger mine produced 3 percent less coal than in 1960. Output was cleaned by jigs at the Half Moon cleaning plant and by hydroseparators at the Beech Bottom plant of Windsor Power House Coal Co. Six mobile loading machines loaded 96 percent of the underground output into shuttle cars.

Brilliant Sand Co., Follansbee, produced fire or furnace sand and fill gravel. Duquesne Sand Co., Beech Bottom, produced sand and gravel for building and paving. Crushed sandstone for roadstone was produced by the State road commissioner.

Cabell.—Sand and gravel was produced chiefly for building and paving by Ohio River Dredging Co. and Union Sand & Gravel Co., both of Huntington. Sand comprised nearly three-fourths of the total output.

Miscellaneous clay (red shale) for building brick was mined near Barboursville by Barboursville Clay Manufacturing Co.

Clay.—Coal production decreased 7 percent, as the number of mines decreased from 11 to 6 (5 underground and 1 auger). Nearly nine-tenths of the production was mined underground. Elk River Coal & Lumber Co., the largest producer, merged with Clinchfield Coal Co., Division of the Pittston Co. The Rich Run coal cleaning plant of Clinchfield cleaned most of the county's output by heavy medium separation. The same tonnage was treated with oil. Six mobile loaders (12 less than in 1960) and 9 hand-loaded face conveyors (5 more than in 1960) loaded 99 percent of the underground coal.

Doddridge.—Sandstone was crushed for use in paving roads at the Doddridge "K" quarry of Feather Construction Co. near West Union.

Fayette.—Although the number of active mines increased by 19 to 167, coal production declined 5 percent. This marked the second consecutive year that the number of mines had increased by 19. Although the county ranked second in number of mines, more than 70 percent of the coal was mined by seven producers. Ranger Fuel Co. purchased and operated for the full year the Beards Fork underground mine, which had been idled by Eastern Gas & Fuel Associates in 1960. An auger mine also was opened by the company in April. The Minden mine of New River and Pocahontas was purchased in July by Minden-Sewell Coal Co. Barbara Gail Coal Co., Inc., purchased the Kaymoor mine of New River and Pocahontas Consolidated Coal Co. in September. Winding Gulf Coal Co. purchased Betty Jo Coal Co. in December.

Ninety-five percent of production was mined underground at 157 mines; three-fourths of this output was mechanically loaded. Equipment included 62 mobile loaders and 13 continuous miners (3 more than in 1960). Of total output, 47 percent was mechanically cleaned, chiefly with jigs; 21 percent was crushed, and 6 percent was treated.

Gilmer.—Coal was the sole commodity produced. Strip- and auger-mined coal production decreased more than 50 percent each owing to the closing of the Rochester & Pittsburgh Coal Co. strip and auger mines. The underground mine and cleaning plant of this company continued operating. Underground production, which comprised 92 percent of total output increased 18 percent. Of the underground coal, 86 percent was mechanically loaded by 9 mobile loaders (5 more than in 1960) and 1 continuous miner. Thirty-nine percent of the total output was crushed.

The sandstone quarry of Basil R. Heavner was idle.

Grant.—Coal production remained virtually the same as in 1960, even though one additional underground mine, operated by H & H Coal Co., was active. Lindsey Coal Mining Co. continued as the sole strip operator. Virginia Electric & Power Co. was granted authority to build a $150 million steam electric generating plant in the county that would use 2.5 to 3 million tons of coal annually.

Bean's Lime & Stone Co., Inc., Petersburg, and Keplinger & Co., Maysville, crushed limestone for concrete aggregate and agstone.

Greenbrier.—Underground coal mining increased one-third, owing to a full year's production at the Anjean Coal Co. mines, which had operated for only the last 2 months of 1960. Strip production decreased one-third owing to the closing of the Burn Rite Coal Co. mine and the decreased production of Lafayette Springs Coal Co. Underground tonnage comprised 74 percent of the total; the balance was output from strip mines. Maust Coal & Coke Corp. merged with Gauley

Coal & Coke Co. Five strip mines used 12 power shovels, 4 draglines, 9 bulldozers, and 15 trucks. Hand loading prevailed in the underground mines, and only 8 percent of the underground coal was mechanically loaded at four operations. Coal was cleaned by heavy medium separation by Anjean Coal Co. and Lafayette Springs Coal Co. Twelve percent of the total output was crushed.

Output of limestone increased 6 percent, as Acme Limestone Co. and H. Frazier Co. continued operations at Fort Spring. Output of H. Frazier Co. was used mainly for railroad ballast, and the production of Acme Limestone Co. was used chiefly for concrete aggregate and roadstone. Lesser quantities were used for railroad ballast, agstone, stone sand, and dust for coal mines. A small quantity of dimension sandstone was produced by Fort Spring Co.

Hampshire.—Limestone production decreased two-thirds, as Terra Alta Limestone Co. was idle for the entire year. Williams Quarry, Inc., Romney, the sole producer, crushed limestone for concrete aggregate and roadstone.

Hancock.—Sand and gravel production increased 28 percent, and although clay production decreased 28 percent, the county continued to rank first in output of both commodities. Sand comprised 49 percent and gravel 51 percent of the sand and gravel output. Almost all of the sand and gravel was used for building purposes. The No. 9 and No. 16 dredge operations of Dravo Corp. supplied the bulk of county output; stationary plants of Arroyo Sand & Gravel Co. and Volino Bros. furnished the balance.

Globe Brick Co., the leading clay producer, Crescent Brick Co., Inc., and West Virginia Fire Clay Manufacturing Co., all of Newell, mined plastic fire clay for firebrick and block, ladle brick, and clay for use in foundries and steelworks.

Hardy.—Limestone was crushed for concrete aggregate and roadstone and for agstone at the Baker Lime plant of the State Soil Conservation Service, Potomac Valley District.

Harrison.—Although underground coal production dropped 2 percent, total production increased 2 percent, owing to increased strip and auger mining. The county ranked seventh in coal production. Strip and auger mines increased from 23 to 30 and 9 to 13, respectively. Together they produced one-fifth of the output. There were 35 power shovels, 4 draglines, 36 bulldozers, 20 drills, and 98 trucks, averaging 15 tons in capacity, used in the strip mines. Almost nine-tenths of underground production was loaded mechanically, using 51 mobile loaders (a decrease of 17) and 8 continuous miners (an addition of 1 by Mountaineer Coal Co.). Seven cleaning plants cleaned 57 percent of the output. Fourteen percent of the output was crushed, and 3 percent was treated, primarily with calcium chloride.

Paul Harrold (Shinnston) crushed limestone and Northview Stone Co., Salerno Bros., and Feather Construction Corp. crushed sandstone for concrete aggregate and roadstone.

Jackson.—Anderson's Black Rock Corp. crushed sandstone at a quarry near Kenna for concrete aggregate.

Jefferson.—The county led in production of stone. Three-fourths of the total output was used for flux in blast and open-hearth furnaces. The balance was used for concrete aggregate and roadstone, railroad ballast, and in the manufacture of dead-burned dolomite. Producers were Michigan Limestone Division, United States Steel Corp.; Blair Limestone Division, Jones & Laughlin Steel Corp.; and Standard Lime & Cement Co., Division of Martin Marietta Corp., all of Millville. Standard Lime & Cement Co. also manufactured refractory lime which was used chiefly in Pennsylvania.

Kanawha.—Production of coal decreased 2 percent, even though the number of mines increased by 8 to 128. The county dropped from fourth to fifth in production. Almost nine-tenths of the output was mined underground, and the balance was mined at two strip and eight auger mines. The Dana No. 2 mine of Amherst Coal Co. ceased operations in February. The Star Slope mine of Avon Mining Corp. was abandoned in April. Carbon Fuel Co. opened three new mines, the No. 20 in April (underground) and the Nos. 20 and 22 (strip and auger, respectively) in June. The D & B Coal Co. did augering under contract for North American Coal Co. Ogelbay-Norton Co. opened two new underground mines (Nos. 13 and 14) in August and December. There were nine active cleaning plants; these facilities prepared 72 percent of the total output. Of the underground coal, 93 percent was mechanically loaded, and 82 percent of the mechanically loaded coal was loaded by 104 mobile loaders. Eleven percent was loaded by 13 continuous miners, (2 less than in 1960). Twenty-nine percent of the coal was crushed, and 6 percent was treated with oil.

Chlor-Alkali Division, FMC Corp., produced salt in brine for manufacturing chlorine. Output was slightly less than in 1960. Bromine compounds and calcium-magnesium chloride also were produced. Tony Pacifico Co. quarried sandstone near Charleston for refractory use and for use as irregular-shaped building stone. Mazzella Quarries, Inc., South Charleston, crushed sandstone for concrete aggregate and roadstone. Fire-clay producers were Charleston Clay Products Co. and West Virginia Brick Co., both of Charleston. Output was for building brick.

Lewis.—Total coal production decreased 5 percent. However, strip mining by three companies increased and comprised more than 70 percent of the total coal output. The balance was obtained from one underground mine and three auger mines. Strip mines used 15 power shovels, 17 bulldozers, and 27 trucks, averaging 12 tons in capacity. The average thickness of the overburden was 43 feet. Keeley Construction Co. continued operation of its jig coal cleaning plant. The entire output was crushed.

Weston Stone Co., Weston, and Feather Construction Corp., Buckhannon, crushed sandstone for concrete aggregate and roadstone. Output was only about one-fourth that of 1960. Miscellaneous clay for building brick and heavy clay products was mined by Weston-Jane Lew Brick & Tile Co. at the Nos. 1 and 2 mines at Weston and Jane Lew, respectively.

Lincoln.—Coal was dredged from the Guyandot River by Campbell Brown Coal & Sand Co., Davis & Adkins Coal & Sand Co., Dial Coal Co., and Ferrellsburg Coal & Sand Co. Coal production increased by one-third over that of 1960.

Engine sand was produced by Davis & Adkins Sand Co., Ferrellsburg. Dean Coal & Sand Co. was idle.

Logan.—Coal production was 2 million tons less than in 1960 (a 13-percent decrease). However, the county continued to rank first in coal production and second in value of mineral production. The number of mines decreased by 8 to 62 (58 underground and 4 auger). Amherst Coal Co.'s McGregor Nos. 1 and 2 mines closed in January, idling over 150 men. Island Creek Coal Co. closed its No. 7 in March, idling 135 men, but in July 70 furloughed miners went back to work at the Holden No. 22 mine, where 18 men had lost their lives in a fire in March. The No. 8 mine of Lorado Coal Mining Co. closed in March, idling 125 men, but 66 men were reemployed at yearend, when the No. 10 mine of the company was opened. Ethel Mines, Inc., abandoned its operation in July, idling 104 men.

The leading coal producers were Island Creek Coal Co., Amherst Coal Co., Omar Mining Co., Princess Coals Co., Inc., and Lorado Coal Mining Co. These companies produced 73 percent of the total output; they employed an average of 3,000 men in 21 mines. Virtually the entire underground output was mechanically loaded by 158 mobile loaders (21 less than 1960), 7 continuous miners (5 less than 1960), and handloaded conveyors. Mobile loaders handled 95 percent. Twenty cleaning plants prepared 95 percent of the total output. The Rex No. 6 plant of Jewell Eagle Coal Co. was idle. Thirteen percent of the coal was crushed, and 15 percent was treated.

Marion.—Coal production increased 2 percent, and the county moved from fifth to fourth place in coal output. Thirteen mines, 10 underground and 3 strip, were active. Mountaineer Coal Co. Consol No. 63 mine, after 70 years of continuous operation and more than 35 million tons of production, depleted its coal reserve and closed in February. This company, with four remaining operations, was the largest producer. Bethlehem Minerals (two operations), Eastern Gas & Fuel Associates, Rochester & Pittsburgh Coal Co., and Joanne Coal Co. followed in that order. Continued modernization of the county mines was noted, as 49 continuous miners (7 more than in 1960) loaded 82 percent of the underground output, compared with 69 percent in 1960. The number of mobile loading machines dropped from 45 in 1960 to 21 in 1961. The percentage of output loaded by these machines decreased from 31 percent in 1960 to 17 percent. Each of the larger coal-mining companies operated its own cleaning plants, cleaning 84 percent of the county's output. Of the total output, 42 percent was crushed, and 4 percent was treated with calcium chloride and oil.

Marshall.—Coal production came from three underground mines operated by Hanna Coal Co., Valley Camp Coal Co., and the State Board of Control. Virtually the entire output was mechanically loaded by 2 mobile loaders and 15 continuous miners (4 less than in 1960). Chance cones and jigs cleaned four-fifths of the output, and 8 percent was crushed.

Salt was produced by Pittsburgh Plate Glass Co. Chemical Division, New Martinsville, and Solvay Process Division of Allied Chemical Corp., Moundsville. Output was used in manufacturing chlorine and other chemicals. Marshall County ranked first among the State's three salt-producing counties.

Mason.—Coal production increased 2 percent. Output from 10 underground mines comprised 78 percent of the output; the balance was from 1 strip and 1 auger mine. Almost nine-tenths of the underground coal was loaded mechanicaly by eight mobile loaders (three less than 1960) and six hand-loaded face conveyors. Of the total output, 86 percent was crushed; there was no cleaning.

Salt output from Liverpool Salt Co., Hartford, was used by feed dealers and feed mixers, water-softener manufacturers, grocers, and meatpackers. Sand and gravel production for building and paving increased more than one-third. Mason Aggregates, Inc., West Columbia, a new producer, and Letart Sand & Gravel, Inc., New Haven, were the two producers.

McDowell.—The county ranked second in coal production and first in value of mineral production. Although the number of mines decreased by 12 to 172, the county led in number of active mines. Underground mines accounted for 96 percent of the total output. The balance was from 15 strip and 15 auger mines. The No. 4 mine of Cannelton Coal Co. closed temporarily in February, idling 35 men. In June, the Berwind Nos. 9 and 11 mines were sold to Superior Pocahontas Mining, Inc., but they remained idle throughout the year. These two mines when working at capacity employed approximately 340 men. In August, Pocahontas Fuel Co. purchased the Berwind Nos. 2 and 5 mines from the New River & Pocahontas Coal Co.

The largest producers, in order of decreasing production, were United States Steel Corp., Eastern Gas & Fuel Associates, Island Creek Coal Co., Olga Coal Co., and Bishop Coal Co. Bishop Coal Co. was formerly Pocahontas Fuel Co., Division of Consolidation Coal Co., Bishop mine. The new Bishop Coal Co. was formed as a merger of Inland Steel Co. and Consolidation Coal Co. under the management of Consolidation. The county led in number of continuous miners with 73; these loaded 60 percent of the underground output. Forty percent was loaded by 62 mobile loaders (20 less than 1960). Four duckbills and eight face conveyors were also active. Eighty-five percent of total output was mechanically cleaned at 17 plants; 49 percent was crushed, and 46 percent was treated with oil. Eastern Gas & Fuel Associates began major additions to its Keystone coal-preparation plant. The first phase, a heavy-medium washer, began operating in July, and a heavy-medium cyclone began operating in August. Future plans called for froth flotation cells, large blending bins, and centrifugal-drying facilities.

The State Road Commission crushed sandstone for concrete aggregate and roadstone.

Mercer.—Owing to increased coal production by Pocahontas Fuel Co. and five new mines, output of coal increased 32 percent. Twenty-six underground mines produced 94 percent of the output; 3 strip and 1 auger mine furnished the balance. The Arista mine of Weyanoke Coal & Coke Co., which had been closed in August 1960, was leased to Arista Mining Co., Inc., and reopened in December. Ninety percent of the coal was cleaned, and 14 percent was treated with oil. Eleven mobile loading machines (a decrease of 4) and 1 continuous miner loaded 80 percent of the underground output.

Limestone was crushed for concrete aggregate and roadstone by Oakville Stone Co., Princeton. Miscellaneous clay for building brick was mined by Virginia Brick & Tile Co., Princeton.

Mineral.—Production of limestone for concrete aggregate and roadstone decreased significantly. Producers were Spencer Lime Co., Keyser, and Aurora Stone Co., Thomas.

Coal production decreased nearly one-half even though a new mine was opened, making a total of five (three handloaded underground mines, one strip mine, and one auger mine).

Mingo.—Despite a 13-percent decrease in coal production, the county rose from 10th to 9th place in coal output. Eighty-four underground mines produced 98 percent of the total; the remainder was mined at 4 auger pits. The Junior mine of Island Creek Coal Co. was idle; Massey Mining Co. No. 1 mine was idled and sold to Phelps Collieries, Inc., in December; and the Alma mine of Sycamore Coal Co. was idle. The number of cleaning plants was reduced by 3 to 8; these plants cleaned 91 percent of total output. Forty-eight mobile loaders and 5 continuous miners loaded 95 percent of the underground coal. One-fifth of the total was crushed, and 16 percent was treated with oil. Island Creek Coal Co. began manufacturing stoker char from bituminous coal at a newly constructed plant at Red Jacket.

Monongalia.—Among the coal-producing counties, Monongalia dropped from sixth to seventh place. Output of 58 underground mines (6 less than in 1960) comprised 99 percent of the total; 5 strip and 1 auger mine furnished the balance. Christopher Coal Co. continued as the leading producer. Sixty-five percent of the coal was cleaned at four cleaning plants. The number of cleaning plants was three less than in 1960, due to the closing of the Christopher Coal Co. No. 6 mine, the Kiskie Coal Co. Canyon Tipple, and the South Union Coal Co. Jamison mine. Fifteen percent of the total output was crushed. Fourteen mobile loading machines and 7 continuous miners loaded 97 percent of the underground tonnage.

Because of sharply increased production by Greer Limestone Co., the county rose to third place among the stone-producing counties. Output was used primarily for concrete aggregate and roadstone and for manufacturing cement. Glass and engine sands were produced by Deckers Creek Sand Co., Masontown.

Morgan.—Glass sand production at the Berkeley works of Pennsylvania Glass Sand Corp. decreased slightly. Output was used chiefly in glass manufacture and as an abrasive for grinding.

Nicholas.—Coal production was virtually the same as in 1960. Ninety-six percent of the output was mined in 100 underground mines, the balance was mined at 3 strip and 6 auger operations. The leading producer, with three mines, was Gauley Coal & Coke Co., which purchased two mines (the Tioga and Saxsewell) from Maust Coal & Coke Corp. on April 1. Forty-eight mobile loading machines (12 less than in 1960), 22 continuous miners (5 more than in 1960), and 108 hand-loaded face conveyors loaded 92 percent of the underground coal. Eight cleaning plants prepared 71 percent of the total output; 10 percent was crushed, and 9 percent was treated.

Nettie Sand Co., Nettie, produced crushed sandstone for concrete aggregate and roadstone.

Ohio.—Coal production from three underground mines increased. Producers were Valley Camp Coal Co. (two mines) and Dependable Coal Co. Jigs and tables cleaned virtually the entire output, and it was mechanically loaded by six mobile loaders. One-third of the output was crushed, and 71 percent was treated with a mixture of calcium chloride and oil.

Output of sand and gravel by Delta Concrete Co., Wheeling, and the Ohio River Sand & Gravel Corp., Parkersburg, decreased significantly. Output was primarily for building and paving.

Pendleton.—Production of limestone, which increased 53 percent, was used for concrete aggregate and roadstone, agricultural purposes, dust for coal mines, and glass manufacture. Producers were Germany Valley Limestone Co. and North Fork Lime Producers, both of Riverton, and Ruddle Lime Co., Franklin.

Pleasants.—Sand and gravel production by Ohio River Sand & Gravel Corp. doubled. Output was for building, paving, railroad ballast, and fill.

Pocahontas.—Coal production decreased 36 percent. Ten mines were active, one less than in 1960. Eight underground mines produced 90 percent of the total; the balance was obtained from one strip and one auger mine. The largest producing mine, operated by Gauley Coal & Coke Co., was purchased from Maust Coal & Coke Corp. in September. Four mobile loaders and 21 hand-loaded face conveyors loaded 96 percent of the underground coal.

A limestone quarry was opened near Marlinton by Terra Alta Limestone Co. Output was for concrete aggregate and roadstone.

Preston.—Coal production decreased 5 percent. Seventy-four underground mines loaded 65 percent of the output; 30 strip mines, 33 percent; and 2 auger mines, the balance. Chapel Coal Co. operated the largest underground mine, and Kingwood Mining Co. operated the largest strip mine. Equipment at strip mines included 35 power shovels, 1 dragline, 25 bulldozers, and 69 trucks, with an average capacity of 16 tons. Thirty-nine percent of the underground production was mechanically loaded by 7 mobile loaders and 22 hand-loaded face conveyors. One-tenth of the coal was cleaned at two plants and 12 percent was crushed.

Because Terra Alta Limestone Co. did not operate in Preston County in 1961, limestone production declined more than two-thirds. Output from Preston Limestone Corp., Terra Alta, was used for concrete aggregate and roadstone and for agricultural purposes. Dimension sandstone for irregular-shaped stone, dressed or cut stone, and flagging was produced by Brookside Stone Co., Brookside.

Putnam.—Coal production increased 24 percent, as the number of active mines increased by 4 to 22. Addition of a strip mine by Whitmire Coal Co. was a leading factor in the increase. The 20 active underground mines were small hand-loading operations. There was one small auger mine.

Sandstone for State roads was produced by the State road commissioner.

Raleigh.—Although coal production was virtually the same as in 1960, the county rose from seventh to sixth place in coal output. Ninety-six percent of the coal was mined at 104 underground mines; the balance was mined at 7 strip and 7 auger mines. More than three-fourths of the total output was produced by Winding Gulf Coals, Slab Fork Coal Co., Eastern Gas & Fuel Associates, Armco Steel

Corp., Oglebay-Norton Co., and New River Co. The Amigo mine of Amigo Smokeless Coal Co. and the No. 3 mine of Lilybrook Coal Co. were abandoned in June, idling 170 men. The Statesbury No. 11 mine of Eastern Gas & Fuels Associates was idle (in 1960 this mine employed 211 men). The Hunter No. 2 mine of the Republic Steel Corp. was sold to Smith & Stover Coal Co. in June, and employment dropped from 134 to 42. Eighty-eight percent of the underground output was loaded by 64 mobile loading machines (10 less than in 1960), 18 continuous miners, and 49 hand-loaded face conveyors (10 more than in 1960). Seventy percent of the output was cleaned at 14 preparation plants. One-tenth was crushed, and 5 percent was treated with oil.

Sandstone was crushed for concrete aggregate and roadstone by the Table Rock Sand Plant, Crow. Beaver Block Co., Beaver, produced sand for building.

Randolph.—Coal production decreased 6 percent. Twenty-five underground mines and 7 strip mines produced 85 and 15 percent, respectively, of the total output. Eighty-six percent of the underground production was loaded by 12 mobile loading machines, 13 continuous miners (an increase of 3), and 16 hand-loaded face conveyors. Forty-five percent of the total output was crushed.

Greater limestone production was reported. Sam G. Polino Co. and Elkins Limestone Co., Elkins, produced crushed limestone chiefly for concrete aggregate and roadstone. A small tonnage was sold for agricultural purposes.

Taylor.—A new coal-stripping operation opened by C&P Coal Co. contributed to a 45-percent increase in coal production. Eighteen mines were active, two less than in 1960. Only a small tonnage was mechanically loaded; most of the coal was loaded by hand. Twenty-three percent of the output was crushed.

Grafton Brick Co. was idle.

Tucker.—Strip-mined tonnage comprised most of the county's coal output. The number of active mines decreased from six to four (one underground and three strip), and production decreased 25 percent.

Fairfax Sand & Crushed Stone Co., Thomas, produced sand for building and paving.

Tyler.—Ohio River Sand & Gravel Corp. doubled production of sand and gravel. Nine-tenths of the output was used for paving; the remainder was used for building, railroad ballast, and fill. Sandstone was crushed for paving by the State road commissioner.

Upshur.—The number of active coal mines decreased by four but production increased 7 percent. Ninety-three percent was mined underground at 24 mines; the balance was mined at 4 strip mines. Christopher Mining, Inc., sold its No. 9 mine to Mutual Coals, Inc., on May 1. Pecks Run Coal Co., Reppert Fairmont Coal Co., and Mutual Coals, Inc., were the leading producers. Eleven mobile loading machines (4 more than in 1960) and 4 continuous miners (2 more than in 1960) loaded 87 percent of the underground coal. Sixty-eight percent of the coal was cleaned at four preparation plants; 56 percent was crushed, and 4 percent was treated.

Sandstone for concrete aggregate and roadstone was crushed by Basil R. Heavner, French Creek.

Wayne.—Coal production, from three small underground mines, increased 10 percent.

Tri-State Stone Corp., Neal, quarried sandstone for concrete aggregate. Traction and building sand was produced by Laval Sand Co., Inc., Fort Gay.

Webster.—Coal production rose significantly, as the number of active mines increased by 12 to 33. Most of the coal was mined from 32 underground mines. One strip mine was active. The Bergoo No. 4 mine, idled in 1959 by R. D. Pardee and Curtain, was reactivated by Bergoo Corp. in February. Reactivation of the Bergoo No. 4 cleaning plant increased the number of active preparation plants to two; these operations cleaned three-fifths of the total output. Three-fourths of the underground coal was mechanically loaded by 8 mobile loaders, 6 continuous miners (2 more than in 1960), and 19 hand-loaded face conveyors. Thirteen percent was crushed, and 26 percent was treated.

Wetzel.—Sand and gravel was dredged from the Ohio River, New Martinsville, by Ohio Valley Sand Co.

Wood.—Sand and gravel was produced by Kanawha Sand Co. and Ohio River Sand & Gravel Corp., both of Parkersburg. Output, which decreased 27 percent, was used for building and paving, railroad ballast, and fill. Pfaff & Smith Builders Supply Co. was idle.

Wyoming.—The county ranked third in coal output. The number of mines decreased by 27 to 66, but production decreased only 3 percent, for it was mostly smaller operations that went out of business. Five leading producers, Eastern Gas & Fuel Associates; Pocahontas Fuel Co., Inc.; Semet-Solvay Division, Allied Chemical Corp.; Island Creek Coal Co.; and Amigo Smokeless Coal Co. mined more than two-thirds of the total coal output. The balance was mined at 56 additional underground mines, 3 strip mines, and 3 auger mines. Eastern Gas & Fuel Associates announced plans to construct a new 11,000-ton-per-day coal preparation plant at its two Kopperston mines, incorporating heavy-medium washers, tables, froth flotation, and thermal drying. Robinson Phillips Coal Co. opened an underground mine and a jig cleaning plant in January. Sixteen cleaning plants processed almost nine-tenths of the output. Underground mines loaded 95 percent mechanically with 102 mobile loaders (20 less than in 1960), 38 continuous miners (2 more than in 1960), 12 duckbills and 10 hand-loaded face conveyors. Twenty-four percent of the total output was crushed, and 15 percent was treated with oil.

Crushed sandstone for road paving was produced by the State road commissioner.

The Mineral Industry of Wisconsin

This chapter has been prepared under a cooperative agreement for collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wisconsin.

By Samuel A. Gustavson[1]

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MINERAL output in Wisconsin was valued at $72.9 million in 1961, the second highest on record, and was exceeded only by the 1960 production, which was valued at $77.2 million. Nonmetals represented 82 percent of the value of minerals produced in the State, compared with 76 percent in 1960. The value of metals output was considerably less than in 1960 and that of nonmetals was slightly higher.

TABLE 1.—Mineral production in Wisconsin[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasive stones: Pebbles (grinding) and tube-mill liners..........short tons..	397	$12	560	$17
Clays..........thousand short tons..	144	156	126	130
Iron ore (usable) thousand long tons, gross weight......	1,502	(2)	1,122	(2)
Lead (recoverable content of ores, etc.).....short tons..	1,165	273	680	140
Lime..........thousand short tons..	(2)	(2)	161	2,480
Peat..........short tons..	8,500	(2)	(2)	(2)
Sand and gravel..........thousand short tons..	35,681	25,648	39,978	28,457
Stone..........do....	16,486	22,302	13,418	19,686
Zinc (recoverable content of ores, etc.)......short tons..	18,410	4,750	13,865	3,189
Value of items that cannot be disclosed: Cement, gem stones, and values indicated by footnote [2]..........	....	25,619	....	19,649
Total Wisconsin [3]..........	....	77,171	....	72,886

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Figure withheld to avoid disclosing individual company confidential data.

[3] Total adjusted to eliminate duplicating value of clays and stone.

Consumption, Trade, and Markets.—Sand and gravel production, especially gravel output for highway use, increased in 1961. The market increase for gravel resulted from a higher proportion of fill and subsurface work on highways, compared with the preceding year. Sales

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[1] Chief, Pittsburgh Field Office, Division of Mineral Resources, Bureau of Mines, Pittsburgh, Pa.

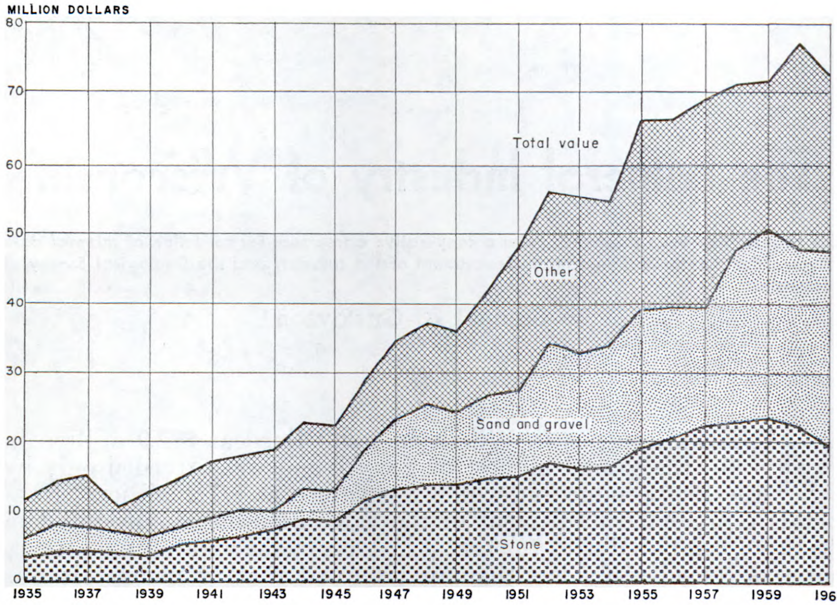

FIGURE 1.—Value of sand and gravel, stone, and total value of all minerals produced in Wisconsin, 1935–61.

of abrasive stones increased slightly in the face of strong competition from foreign sources and from synthetic stone produced in the United States. Low prices for lead and zinc were reflected by curtailment of production and development of deposits in the southwestern part of the State. Demand for iron ore was slightly better than in 1960. However, higher grade iron ore from foreign countries and the high-grade, uniformly structured taconite pellets were taking the ore market away from direct-shipping grades. It was becoming increasingly difficult to sell ore containing less than 60 percent iron. Average iron content, natural, of Wisconsin iron ore shipped was 54 percent.

Trends and Developments.—The possibility of erecting a taconite plant in Iron County was being explored. The New Jersey Zinc Co. continued to drive an incline tunnel to a zinc deposit near Elmo.

TABLE 2.—Employment and injuries for selected mineral industries [1]

Year and industry	Average number of men working	Total man-hours	Total number of lost-time injuries		Injury frequency rate [2]
			Fatal	Nonfatal	
1960:					
Clays [3]	64	79,643			
Granite	116	231,817		10	43.14
Limekiln [4]	126	327,606		8	24.42
Limestone [5]	1,482	2,475,020		111	44.85
Marl	6	5,330			
Sand and gravel	2,088	3,464,016	1	71	20.79
Sandstone	115	199,433		2	10.03
1961: [6]					
Clays [3]	31	38,153			
Granite	118	237,850	1	10	46.25
Limekiln [4]	117	282,805		12	42.43
Limestone [5]	1,197	2,040,844		74	36.26
Marl	4	3,600			
Sand and gravel	2,747	4,363,691	1	17	4.12
Sandstone	106	190,890		7	36.67

[1] Excludes officeworkers.
[2] Total number of injuries per million man-hours.
[3] Excludes pits producing clay used exclusively in manufacturing cement.
[4] Includes limestone quarries producing raw material used in manufacturing lime.
[5] Excludes quarries producing limestone used exclusively in manufacturing cement and lime.
[6] Preliminary figure.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Baraboo Quartzite Co. produced tube-mill liners and grinding pebbles from hard quartzite mined near Baraboo in Sauk County. The mill liners and pebbles were used to grind materials that should be kept free of even minute quantities of iron, such as certain paint pigments, silica sand, and chemical compounds. Competition for sales continued with low-cost pebbles imported from Europe and with artificial abrasive materials manufactured in the United States; however, sales by Baraboo Quartzite Co. were higher in 1961. The company's quarry operation was similar to many dimension stone quarries. Tube-mill liners were cut to specifications furnished by the buyer. Grinding pebbles usually were cut to standard sizes.

Cement.—Demand for portland and masonry cements in Wisconsin was met partly by the output of two local plants and partly by cement shipped from plants in Illinois, Indiana, Iowa, Michigan, and Minnesota. Total sales of portland cement within the State increased 10 percent over 1960; sales of masonry cement increased 31 percent.

Manitowoc Portland Cement Co., subsidiary of Medusa Portland Cement Co., manufactured portland cement at Manitowoc, using limestone from Michigan and clay obtained locally. This company had four kilns and made cement by the wet process.

Marquette Cement Manufacturing Co. produced portland and masonry cements at Milwaukee, using limestone from Michigan and shale from Illinois. Marquette had one large kiln and used a dry process.

Cement consumed in the State was also shipped from plants in Illinois, Indiana, Iowa, Michigan, and Minnesota. Universal Atlas Cement Co. shipped ground clinker from its plant in Indiana to a grinding plant in Milwaukee. Huron Portland Cement Co. maintained storage silos at Milwaukee and at Green Bay for cement made in a Michigan plant. Other companies shipping cement into the State had no particularly large storage or grinding facilities.

All cement produced in the State was of types I and II, general use and moderate heat. The capacity of the two producing plants in Wisconsin in 1961 was rated slightly higher than in 1960, although the number or size of kilns installed had not changed. The average mill value per 376-pound barrel of portland cement was about $3.40, compared with slightly over $3.30 in 1960.

Cement produced in the State was shipped mostly in bulk and by truck.

Clays.—Miscellaneous clay or shale in Wisconsin was produced by seven companies, compared with eight in 1960. In 1961, no clay output was reported by Marshfield Brick & Tile Co. at Marshfield in Marathon County. All clay was used in manufacturing products by each company. No clay was sold. A major portion of the output was used in manufacturing cement. The remainder was used in making building brick, draintile, and other heavy clay products. Clay consumed for manufacturing portland cement increased in 1961, but clay consumed in making miscellaneous heavy clay products declined 44 percent. Since raw clay was not sold, it had no actual sales value. The value assigned in this chapter is an approximate mining cost. Clay was produced in Brown, Dunn, Fond du Lac, Manitowoc, Racine, and Waupaca Counties.

Lime.—Output of lime increased about 7 percent over 1960. During 1961 producers of quicklime and hydrated lime for use within their own manufacturing plant were added to the lime canvass. Therefore, data for total production of lime in 1961 are not comparable with those of previous years. Production of quicklime and hydrated lime by Menominee Sugar Co. at Green Bay, by Mosinee Paper Mill Co. at Mosinee, and by Thilmany Pulp & Paper Co. at Kaukauna was added to the total in 1961. The number of producers of lime for sale to industry remained unchanged. These companies sold 3 percent less than in 1960. Sales of both quicklime and hydrated lime decreased about the same proportion. Lime, in order of decreasing quantities, was used for the following purposes: Paper manufacture, mason's lime, water purification, metallurgy, insecticides, fungicides and disinfectants, sugar refining, agriculture, polishing compounds, and plastics. As in 1960, about 23 percent of all the quicklime was hydrated. Hydrated lime represented nearly 29 percent of the total weight of the quicklime and hydrated lime sold or used in Wisconsin in 1961.

Companies producing lime for sale were The Western Lime & Cement Co., with plants in Brown, Douglas, and Fond du Lac Counties; Mayville White Lime Works, Dodge County; Cutler-LaLiberte-McDougall Corp., Douglas County; and Rockwell Lime Co., Manitowoc County.

Perlite.—Perlite was expanded in plants of Western Mineral Products Co. at Milwaukee and Midwest Perlite Co. at Applington. Crude perlite was purchased from mines in Nevada, New Mexico, and Colorado. Expanded perlite was sold mostly for use in manufacturing lightweight concrete. A small percentage was used in building plaster. The value and quantity of sales was about 8 and 11 percent less than in 1960. Western Mineral Products Co., Milwaukee, also exfoliated vermiculite from crude materials shipped in from Libby, Mont. Exfoliated vermiculite was sold chiefly for loose fill insulation, fireproofing, and acoustical purposes.

Sand and Gravel.—According to the State highway commission, a large percentage of Wisconsin highway construction in 1960 was finishing and surfacing. In 1961, a greater proportion of highway work was for fill and base courses, which consume relatively large tonnages of gravel and rock. The 5-million-ton increase in consumption of gravel for paving and highway construction (6.5 million tons in 1960 to 11.6 million tons in 1961) reflected this difference in the stage of road construction. The use of crushed limestone for paving and roadbuilding declined in 1961, indicating that availability of gravel in areas of construction was better. Production of sand and gravel for the State totaled nearly 40 million tons and was valued at $28.5 million, compared with 35.7 million tons valued at $25.6 million in 1960.

Sand and (or) gravel had been produced in every county in the State. During 1961 production was reported from 63 counties; several operators, however, did not indicate the source of their output. Most of the production of sand and gravel, 72 percent, was for highway use; 17 percent was for building uses. The quantity and value of sand and gravel for building use increased 7 percent and 2 percent, respectively, over 1960, indicating that building activity was slightly greater and that competition for work continued.

Industrial sand production continued to increase. Uses included foundry, engine, blast, filter, and hydrofractionating. Surface or near-surface deposits in Clark, Portage, Sauk, and Wood Counties supplied most of the State's industrial sand. Preparation for marketing usually required special equipment for sizing and removing unwanted contaminants.

The 10 leading commercial operators producing sand and gravel were Consumers Co., Division of Vulcan Materials Co., Chicago; Courtney & Plummer, Inc, Neenah; Janesville Sand & Gravel Co. and Wm. J. Kennedy & Son, Janesville; Edward Kraemer & Sons, Inc., Plain; Arthur Overgaard, Inc., Elroy; Ozaukee Sand & Gravel Co., Milwaukee; Plautz Brothers, Inc., Willard; State Sand & Gravel Co., Milwaukee; and Wissota Sand & Gravel Co., Eau Claire.

Stone.—Dimension stone was produced from granite, limestone, and sandstone deposits within the State. Granite output was slightly less in both tonnage and value than in 1960. The tonnage of dimension limestone was less than in 1960; however, the value was greater. During 1960 a higher percentage of limestone had been produced in the form of rough stone or blocks for use as rubble; in 1961 the output of dimension stone for architectural use increased. Dimension sandstone production was down about 25 percent in both quantity and

TABLE 3.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:[1]				
Molding	83	$178	106	$266
Building	3,071	2,711	3,378	2,852
Paving	2,615	2,099	2,814	2,054
Railroad ballast	105	84	102	81
Fill	751	413	874	451
Other[2]	205	276	282	303
Total	6,830	5,761	7,556	6,007
Gravel:				
Building	3,409	3,198	3,570	3,184
Paving	10,306	7,960	9,401	6,836
Railroad ballast	503	365	415	291
Fill	773	385	608	346
Other	1,053	913	946	801
Total	16,044	12,821	14,940	11,458
Total sand and gravel	22,874	18,582	22,496	17,465
Government-and-contractor operations:				
Sand:				
Building	(3)	(4)	----------	----------
Paving	5,938	3,007	5,401	2,762
Fill	408	151	481	184
Other	----------	----------	34	18
Total	6,346	3,158	5,916	2,964
Gravel:				
Paving	6,307	3,857	11,311	7,913
Fill	154	51	249	111
Other	----------	----------	6	4
Total	6,461	3,908	11,566	8,028
Total sand and gravel	12,807	7,066	17,482	10,992
All operations:				
Sand	13,176	8,919	13,472	8,971
Gravel	22,505	16,729	26,506	19,486
Grand total	35,681	25,648	39,978	28,457

[1] Includes friable sandstone.
[2] Includes sand for engine, blast, filter, oil (hydrafrac), and other industrial sand (1960–61).
[3] Less than 500 short tons.
[4] Less than $500.

value. The stone was used mostly in constructing buildings. Some was used for flagging, and some was used for riprap. In total dimension stone, cubic footage produced was greater than in 1960; however, tonnage was slightly less, and value increased about 1 percent. Dimension granite was produced from quarries in Marathon, Marquette, and Waushara Counties. Marathon County quarries produced by far the greatest portion. Crushed stone was produced from basalt, granite, marble, limestone, sandstone, and quartzite. Basalt was produced in Marinette County, chiefly for manufacturing roofing granules. The mineral is actually an andesite. The material is hard and crushes satisfactorily for use in manufacturing roofing granules. In Polk

County, basalt and traprock were produced mainly for roadstone and railroad ballast.

TABLE 4.—Limestone sold or used by producers, by uses[1]

Use	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction____thousand short tons__	7	$65	12	$95
Rubble____do____	56	151	23	91
Rough architectural____thousand cubic feet__	2	1	5	9
Dressed (cut and sawed)____do____	418	1,042	479	1,167
Flagging____do____	118	113	108	102
Total approximate thousand short tons[2]____	106	1,372	83	1,464
Crushed and broken:				
Riprap____thousand short tons__	93	132	143	118
Concrete aggregate and roadstone____do____	12,918	12,812	9,895	9,960
Agriculture____do____	1,216	1,719	1,322	1,837
Lime____do____	89	105	84	93
Other[3]____do____	168	244	135	190
Total____do____	14,484	15,012	11,579	12,198
Grand total____do____	14,590	16,384	11,662	13,662

[1] Includes both commercial and Government-and-contractor production.

[2] Average weight of 160 pounds per cubic foot used to convert cubic feet to short tons.

[3] Includes limestone for railroad ballast (1960), flux, papermills, asphalt, fertilizer, filter beds, and other uses.

A decomposed granite deposit in Marathon County was mined for road surfacing. Some trimmings and pieces of granite not suitable for dimension purposes were crushed for use in local areas as a concrete aggregate. A dolomitic marble deposit was mined in Bayfield County. The material was crushed, and the chips used in manufacturing synthetic stone.

Crushed and broken limestone, for both commercial and Government-and-contractor uses, was produced in quarries in 37 counties. The major uses were for highway construction and agriculture. Other uses for crushed limestone included asphalt filler, fertilizer filler, filter beds, and for manufacturing lime. Considerable tonnage also was used as a metallurgical flux. Production of crushed limestone decreased nearly 3 million tons from 1960.

Slightly less sandstone and quartzite were produced than in 1960, and were used chiefly for railroad ballast, foundry sand, and roofing granules. Other important uses of ground sandstone or quartzite included concrete aggregate, silica brick, glass sand, and abrasives (such as sandpaper). One quartzite deposit was quarried to produce grinding pebbles and tube-mill liners. An argillite deposit furnished the raw material for the manufacture of roofing granules. The order of use for sandstone and quartzitic rock, other than as dimension stone, was as railroad ballast, concrete roadstone, concrete aggregate, refractories, roofing granules, foundry sand, glass sand, abrasives, filler, and filter. All uses for crushed sandstone, quartz, and quartzite declined in 1961, except for silica brick (refractory), which increased moderately.

METALS

Iron Ore.—Production of iron ore came from two underground mines on the Gogebic Range in Iron County, the Montreal, operated by Oglebay Norton & Co., and the Cary, operated by Pickands Mather & Co. The ore was of direct-shipping grade. During the year, 1,121,636 tons was shipped, of which 546 tons was shipped all-rail, and the remainder by boat. About 918,000 tons was shipped through the Ashland, Wis. port and 203,000 tons through the Escanaba, Mich. port. Both the Montreal and Cary mines were producing from below the 3,000-foot level. The Montreal mine was developed to 4,335 feet, vertical depth, below the surface. The Cary mine was developed to the 37th level, about 3,600 feet deep. Both mines were operated on sublevel caving or modified sublevel caving methods. The Montreal mine was operated throughout 1961, although only on a 4-day work week for part of the year. The Cary mine was closed from March 16 to October 16; on reopening, this mine was also operated on a 4-day workweek. Low demand for ore was the basic reason for curtailment of production. No production came from Florence County.

TABLE 5.—Iron-ore production and shipments

Year	Number of mines	Production (thousand long tons)	Shipments (thousand long tons)	Iron content of shipments natural (percent)
1957	3	1,618	1,576	52.32
1958	2	1,152	867	53.72
1959	4	944	701	53.39
1960	4	1,484	1,502	53.50
1961	2	1,129	1,122	53.61

Base prices per long ton for iron ores were unchanged from those posted January 30, 1957, as follows: High Phosphorus, $11.45; Mesabi Non-Bessemer, $11.45; Mesabi Bessemer and Old Range Non-Bessemer, $11.70; and Old Range Bessemer, $11.85. Prices for iron ore included all shipping costs from the mines to lower Lake ports; these costs do not appear in the total value of iron-ore output of Wisconsin. The base prices were for ores grading 51.50 percent iron (natural) and for Bessemer ores containing less than 0.045 percent phosphorus (dry). Ores higher than 0.18 percent phosphorus (dry) were classed as High Phosphorus. Variations in grade from this base and diversities in physical structure from established norms called for premiums or penalties.

Shipments from the port of Ashland began May 11 and ended November 20. For Escanaba the navigation season for iron ore shipments began April 24 and closed November 25.

Investigation of low-grade iron or magnetic iron deposits near Butternut reportedly continued.

Lead and Zinc.—Output of lead decreased 42 percent in quantity and 49 percent in value and that of zinc decreased 25 percent in quantity and 33 percent in value as markets for these commodities were depressed.

The Mining & Smelting Division of Eagle Picher Co. operated the Shullsburg mine and mill throughout the year. The mine is about 2½ miles south of Shullsburg. The company also did development work on the Birkett-Bastian-Andrews mine near Hazel Green. Production was curtailed for the year because the price of metals was low. Ore from the Brikett-Bastian-Andrews mine was shipped to Eagle Picher's Graham, Ill., mill for concentration. The company Kickapoo mine, near Linden in Iowa County was inactive.

The American Zinc, Lead & Smelting Co., Vinegar Hill Zinc Division, operated the Blackstone, Hancock, Thompson, Temperly, and Winskell mines in Lafayette County. (Mining at the Winskell mine was actually done by the Eagle Picher Co.) The ore was concentrated at the Vinegar Hill mill. The Hancock mine changed from track- to trackless-type haulage. Rails were removed, and all drifts were widened to accommodate off-rail equipment. During 1961 the Winskell mine operated only in January and February.

Piquette Mining & Milling Co. completed a development program at its mine near Tennyson, Grant County, resumed production in March, and continued operating throughout the remainder of the year. Ore was treated at the Piquette mill.

Joe Grimes operated the Burnham mine, in Grant County, from January through May 15, producing a small tonnage of ore that was treated at the Piquette mill.

Mifflin Mining Co. shipped a small quantity of ore from the Bickford, Coker No. 1, and Defense mines in Iowa County. The New Jersey Zinc Co. continued development at its new mine near Elmo in Lafayette County, but the planned construction of a new mill was deferred.

Average yearly weighted prices used to calculate values of lead and zinc in table 1 were 10.3 cents per pound for lead and 11.5 cents per pound for zinc. These prices compare with 11.7 cents per pound for lead and 12.9 cents per pound for zinc in 1960.

TABLE 6.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing		Material treated		Lead		Zinc		Total value
	Lode	Tailings	Ore (short tons)	Tailings (short tons)	Short tons	Value	Short tons	Value	
1952-56 (average)	17	7	628,256	62,451	1,977	$585,879	19,034	$5,023,103	$5,608,982
1957	16	3	710,776	17,066	1,900	543,400	21,575	5,005,400	5,548,800
1958	2	--------	468,822	--------	800	187,200	12,140	2,476,560	2,663,760
1959	6	--------	464,390	--------	745	171,350	11,635	2,676,050	2,847,400
1960	8	1	686,085	993	1,165	272,610	18,410	4,749,780	5,022,390
1961	9	1	465,407	99	680	140,080	13,865	3,188,950	3,329,030

TABLE 7.—Mine production of lead and zinc in 1961, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	65	1 330
February	45	1,355
March	35	1,105
April	40	1,160
May	45	1,105
June	40	1,235
July	60	1,020
August	55	1,155
September	105	1,165
October	70	1,125
November	60	1,060
December	60	1,050
Total	680	13,865

REVIEW BY COUNTIES

Virtually every county produced some sand and gravel or crushed limestone for use in building or highway construction. Reports for 1961 indicated production of one or both of these commodities for 69 of the 71 counties. Several contractors who operated portable plants did not indicate the county source on their reports. Noncommercial or Government-and-contractor reports included State and county highway departments, cities, towns, and full-time contractors for Federal or State projects. Commercial operators were those who produced sand and gravel for retail or wholesale trade; 196 produced sand and gravel, and 107 produced and crushed limestone.

Bayfield.—A dolomitic marble deposit was quarried near Grandview by U.S. Aggregate Co. of Eau Claire. The product was crushed and sold as chips for the manufacture of synthetic stone. In 1960 this quarry had been operated by Wisconsin Marble Heights Quarries, Inc.

Brown.—Clay was produced for the manufacture of building brick, draintile, and other heavy clay products by Duck Creek Brick Co. and Hockers Brothers Brick & Tile Co. The Western Lime & Cement Co., Green Bay, produced lime for commercial sale; Menominee Sugar Co. used its output within its own plant. Sand and gravel and crushed limestone and dolomite were reported by 10 commercial producers and the Village of Howard Highway Department. The leading producers included Daanen & Janssen, Schuster Construction Co., Vic Zeman, Allard & Van Nelson, and W. B. Sheedy Construction Co.

Buffalo.—Limestone for road and agricultural uses was crushed by four companies; the larger companies were Herbert Tiffany, Jr., and Neuheisel Lime Works.

Calumet.—Sand and gravel and crushed limestone, produced in this county, were used mostly on highways.

Sand and gravel production was reported by Sell Brothers Stone & Gravel Co., Stockbridge; Quality Sand & Gravel Co., Wrightstown; and Arnold M. Ortlepp, Hilbert. The Calumet County Highway Commission also purchased or produced sand and gravel and limestone for road use.

Clark.—Dimension sandstone was produced by Ellis Quarries, Inc., for use in building construction and flagging. Sand and gravel was the only other mineral product of the county. Most of the sand and gravel produced was for highway construction and building use.

TABLE 8.—Value of mineral production in Wisconsin, by counties[1]

County	1960	1961	Minerals produced in 1961 in order of value
Adams	(2)	(2)	Sand and gravel.
Barron	$193, 833	$248, 075	Do.
Bayfield	(2)	(2)	Stone.
Brown	1, 083, 562	1, 012, 072	Sand and gravel, lime, stone, clays.
Buffalo	(2)	285, 478	Stone.
Burnett	59, 055	185, 400	Sand and gravel.
Calumet	246, 297	241, 731	Sand and gravel, stone.
Chippewa	18, 170	15, 400	Sand and gravel.
Clark	450, 605	534, 607	Sand and gravel, stone.
Columbia	1, 478, 915	1, 622, 714	Stone, sand and gravel.
Crawford	213, 875	210, 178	Do.
Dane	1, 809, 914	1, 678, 330	Sand and gravel, stone.
Dodge	1, 336, 528	1, 061, 513	Sand and gravel, lime, stone.
Door	358, 349	268, 130	Sand and gravel, stone.
Douglas	(2)	(2)	Lime, sand and gravel.
Dunn	175, 073	(2)	Sand and gravel, clays.
Eau Claire	(2)	(2)	Sand and gravel, stone.
Florence	(2)	------------	
Fond du Lac	1, 319, 331	1, 351, 711	Stone, sand and gravel, lime, clays.
Forest	84, 170	70, 049	Sand and gravel.
Grant	886, 350	760, 577	Stone, zinc, sand and gravel, lead.
Green	388, 639	345, 137	Stone, sand and gravel.
Green Lake	234, 564	289, 411	Sand and gravel.
Iowa	637, 010	292, 572	Stone, sand and gravel, zinc.
Iron	(2)	(2)	Iron ore, sand and gravel.
Jackson	(2)	(2)	Sand and gravel.
Jefferson	159, 124	199, 077	Sand and gravel, stone.
Juneau	(2)	(2)	Stone, sand and gravel.
Kenosha	232, 584	90, 920	Sand and gravel.
Kewaunee	127, 411	294, 870	Do.
La Crosse	102, 628	(2)	Sand and gravel, stone.
Lafayette	(2)	(2)	Zinc, lead, stone.
Langlade	284, 607	174, 800	Sand and gravel.
Lincoln	137, 940	145, 052	Do.
Manitowoc	(2)	(2)	Cement, sand and gravel, lime, stone, clays.
Marathon	2, 854, 133	2, 862, 414	Stone, sand and gravel, lime.
Marinette	(2)	(2)	Stone, sand and gravel.
Marquette	265, 211	279, 758	Do.
Milwaukee	5, 568, 869	(2)	Cement, stone, sand and gravel.
Monroe	103, 167	103, 030	Stone.
Oconto	148, 759	161, 427	Sand and gravel.
Oneida	150, 665	221, 757	Sand and gravel, stone.
Outagamie	497, 070	545, 639	Sand and gravel, stone, lime.
Ozaukee	195, 425	283, 474	Sand and gravel.
Pepin	5, 303	1, 053	Do.
Pierce	417, 109	223, 871	Sand and gravel, stone.
Polk	496. 112	311, 619	Stone, sand and gravel.
Portage	(2)	340, 057	Sand and gravel, stone.
Price	3, 154	19, 630	Sand and gravel.
Racine	1, 822, 205	1, 296, 558	Stone, sand and gravel, clays.
Richland	(2)	(2)	Stone, sand and gravel.
Rock	1, 533, 220	1, 448, 051	Sand and gravel, stone.
Rusk	83, 022	(2)	Do.
St. Croix	677, 456	605, 867	Do.
Sauk	1, 738, 637	1, 641, 218	Stone, sand and gravel, abrasives.
Sawyer	63, 323	76, 691	Sand and gravel.
Shawano	469, 224	286, 833	Sand and gravel, stone.
Sheboygan	482, 799	524, 414	Do.
Taylor	189, 777	(2)	Sand and gravel.
Trempealeau	(2)	(2)	Stone.
Vernon	(2)	460, 913	Stone, sand and gravel.
Vilas	63, 135	43, 536	Sand and gravel.
Walworth	591, 872	496, 538	Do.
Washburn	71, 034	(2)	Do.
Washington	1, 235, 010	1, 177, 241	Sand and gravel, stone.
Waukesha	5, 848, 522	5, 986, 939	Sand and gravel, stone, peat.
Waupaca	115, 365	(2)	Stone, sand and gravel, clays.
Waushara	(2)	79, 179	Sand and gravel, stone.
Winnebago	2, 262, 803	2, 147, 832	Stone, sand and gravel.
Wood	(2)	(2)	Stone.
Undistributed[3]	38, 788, 005	40, 744, 322	
Total[4]	77, 171, 000	72, 886, 000	

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[1] No production reported for Ashland County.

[2] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Includes some sand and gravel and stone that cannot be assigned to specific counties and values indicated by footnote 2.

[4] Total adjusted to eliminate duplicating value of clays and stone.

Leading producers were Plautz Brothers, Inc., Willard, and Edward Kraemer & Sons, Inc., Plain.

Columbia.—Sandstone was the most important mineral product. Manley Sand Division, Martin-Marietta Corp. (formerly Portage-Manley Sand Co.), produced sandstone for use in foundries and in glass. A small quantity was sold for dusting purposes on highways. Sand and gravel was produced by several companies, the largest of which were Edward Kraemer & Sons, Inc.; C. C. Linck, Inc.; and J. M. Owen. Columbia County Highway Department produced sand and gravel for highway use. Some sandstone was produced by the county and also by Dann & Wendt. The production was used mostly on highways.

Crawford.—Prairie Sand & Gravel, Inc., and Lakeside Sand & Gravel Co. produced material for road use. Three companies reported production of limestone, chiefly for road use. They were Loren J. Slaght, Edward Kraemer & Sons, Inc., and Velmer Monroe.

Dane.—Sand and gravel and crushed limestone for road construction were produced. Some sand was produced for molding use. Leading producers of crushed limestone included Madison Stone Co., Inc.; Baumgardt Construction Co.; Hammersley Stone Co., Inc.; Melvin Paulson; Wingra Stone; and Norman Carpenter. Leading producers of sand and gravel included Capitol Sand & Gravel Co.; Hartland-Verona Gravel Co.; F. H. Raemisch Sons, Inc.; Wingra Stone; Speedway Sand & Gravel Co.; Bushman Construction Co.; Sundby Sand & Gravel Co., Inc.; and General Silica Co.

Dodge.—Quicklime and hydrated lime were produced by The Western Lime & Cement Co. and Mayville White Lime Works. Both companies sold crushed limestone and agricultural lime. Sand and gravel was produced by Linck-Henes Construction Co., Inc.; C. C. Linck, Inc.; and Edward Kraemer & Sons, Inc. Dodge County Highway Department also produced sand and gravel for road use.

Door.—Sand and gravel and limestone were produced, chiefly for road and highway construction. Vernon E. Olsen Excavating Co. and Hubert Charles produced sand and gravel. Limestone was produced by Adamski-Fisher Quarry. Also, the Door County Highway Department produced both sand and gravel and crushed limestone.

Douglas.—Cutler-LaLiberte-McDougall Corp. manufactured quicklime and hydrated lime at a plant in Superior. The Douglas County Highway Department and the City Engineer of Superior produced sand and gravel.

Dunn.—Menomonie Brick Co. produced some miscellaneous clay for manufacturing building brick. Edward Kraemer & Sons, Inc., produced sand and gravel for road use.

Eau Claire.—Kenneth Freitag of Eau Claire produced sandstone, chiefly for road use. Wissota Sand & Gravel Co. and Eau Claire Sand & Gravel Co. produced sand and gravel.

Florence.—No iron ore was shipped from this county during 1961.

Fond du Lac.—Oakfield Shale Brick & Tile Co. mined miscellaneous clay and shale for manufacture of building brick and tile. The Western Lime & Cement Co. quarried limestone and operated a plant for manufacturing quicklime and hydrated lime. Leading producers of sand and gravel included Braun Construction Co., Lakeview Sand &

Gravel Co., Cyril Simon, and M. A. Leiberg. Limestone, for road use, was produced by several companies, chiefly by Fond du Lac Stone Co., Inc.; Hamilton Stone Co.; E. Dais Stone Co.; Nellis Limestone Quarry, Inc.; C. C. Linck, Inc.; and Oakfield Stone Quarry. Some dimension limestone was produced.

Grant.—Piquette Mining Co. mine and mill, idle the first part of the year, resumed production in April and operated throughout the remainder of the year. The company also sold some jig tailings for road use. A small quantity of zinc was produced by Joseph Grimes. Dubuque Sand & Gravel Co. produced sand and gravel. Limestone chiefly for highway use was crushed by Becker & Tuckwood, George Wendtlandt, Dell Needham, Bertie & Russel Zenz, Harry Croft & Sons, and others.

Green.—Only highway and road materials were produced. Leading producers of crushed limestone were Rees Construction Co.; P. W. Ryan Sons, Inc.; and Bergen Rock & Lime Co. Henry Altmann and Green County Sand & Gravel Co., Inc., produced sand and gravel.

Green Lake.—Sand sold for molding use was produced by Clifford Chier Sand Co., and glass sand was produced by Chier St. Marie Sand Co. Paul Polenska & Son and Kopplin & Kinas Co., Inc., produced sand for road use. The Green Lake County Highway Commission produced sand and gravel.

Iowa.—In April and May, Mifflin Mining Co. shipped small quantities of zinc ore to Eagle Picher's Graham mill in Illinois. Mineral output was chiefly sand and gravel and crushed limestone. Leading producers of crushed limestone included Ivey Construction Co., George Wendtlandt, and Davis & Richardson. The latter company also produced sand and gravel.

Iron.—All the iron ore produced in Wisconsin came from Iron County. There were two operating mines, the Montreal, managed by Oglebay Norton & Co., and the Cary operated by Pickands Mather & Co. These mines are on the west end of the Gogebic iron range, about 2 miles west of the town of Hurley.

The first shipment from the Montreal mine was recorded in 1886. Through 1961, approximately 44 million tons of iron ore had been shipped from this mine. The Montreal mine, extending approximately 2 miles along the strike of the iron formation, was producing from six levels, all of which were below the 3,100-foot level. Development of the mine extended more than 4,000 feet, vertical measurement, below the surface. Modified sublevel caving and modified sublevel stoping mining methods were used. Sublevels were 50 feet apart. The main hoisting and pumping shaft, No. 5, was 3,036 feet deep vertically, or 1,460 feet below sea level. It was sunk in quartz slate and greenstone. Inside dimensions are 16 feet by 10 feet 9 inches. Two 9½-ton skips made with aluminum bodies and alloy steel liners are used to hoist the ore. Hoisting speeds of the skips and the cage are 2,100 and 1,000 feet per minute, respectively. The No. 5 auxiliary shaft, an underground transfer shaft about 1,100 feet north of Shaft No. 5, was sunk on an incline of 58° to the north from the 31st level. Measured vertically, it is 1,894 feet below the 31st level, or 4,335 feet below the surface. The inside dimensions are 18 feet 7 inches by 11 feet. It has five compartments. The skip hoist is a double drum 10-

foot diameter by 80-inch face, using two 9½-ton skips in balance. Hoisting speed is 1,065 feet per minute. The cage hoist is a single drum, 10-foot diameter by 80-inch face, using a cage that is not counter-balanced. Hoisting speed is 800 feet per minute. Ore and rock are hoisted through the No. 5 auxiliary shaft to the 33d level, where the ore is screened and the plus 4-inch ore is crushed before transferring to the No. 5 shaft. Ore and rock are transferred in a 20-ton "larry" car. The No. 4 shaft is about 3,335 feet deep. It is primarily used as a second outlet and for exhaust ventilation. No. 6 shaft is 4,518 feet deep, inside dimensions 16 feet by 10 feet. It is used primarily for ventilation and pumping water to the 35th level, from which water runs to the No. 5 shaft pumping plant.

The Cary mine, was idle from March 16 to October 16. It has a shaft 3,600 feet deep to the 37th level. It also has an inclined air shaft to the 31st level. A sublevel caving mining method is used, and pillars are recovered. The Cary mine, also opened in 1886, had shipped nearly 16.7 million tons through 1961.

Sand and gravel was produced in the county for highway use, and building construction by Edward Kraemer & Sons, Inc.; Peterson Sand & Gravel; and the Iron County Highway Department.

Jackson.—Laurence Murphy and H. T. Smith produced sand and gravel chiefly for road use.

Jefferson.—Hausz Brothers produced limestone for road use and as agricultural stone. Sand and gravel was produced by Rude Sand & Gravel, Hausz Brothers, and Arne Evensen. The Jefferson County Highway Commission also produced some sand and gravel for road use.

Juneau.—Arthur Overgaard Co. and the Juneau County Highway Commission crushed limestone for road use. The Juneau County Highway Commission also produced some sand and gravel.

Kenosha.—Bloss Sand & Gravel and the Kenosha County Highway Department produced sand and gravel, the only mineral output in the county, chiefly for road use.

Kewaunee.—Sand and gravel was produced by Krueger Construction Co., Schuster Construction Co., and the county highway department.

La Crosse.—Herbert Hass produced dimension limestone for rough construction architectural use and flagging. Tri County Lime Co. crushed limestone chiefly for road use. Sand and gravel was produced by Kammel-Smith Sand & Gravel Co., Inc., and La Crosse Sand & Gravel Co., Inc.

Lafayette.—The Mining & Smelting Division, Eagle Picher Co., operated the Shullsburg mine and mill, producing lead and zinc throughout the year. The mine is about 2½ miles south and one-half mile east of Shullsburg. The zinc concentrate was sent to the Eagle Picher Co. smelter at Galena, Kans. Lead concentrate was sent to St. Joseph Lead Co., Herculaneum, Mo. Eagle Picher Co. performed development the first part of the year at the Birkett-Bastian-Andrews mine. It completed shipments of ore, part of which had been mined in 1960, from the Winskell mine of American Zinc, Lead & Smelting Co. Winskell ore was treated at the Vinegar Hill mill of American Zinc, Lead & Smelting Co. American Zinc, Lead & Smelting Co., Vinegar Hill Zinc Division, operated the Blackstone, Hancock, Thompson, and

Temperly mines during the year. Ore was sent to the Vinegar Hill mill for concentration. New Jersey Zinc Co. continued development of its mine near Elmo but deferred plans to construct a mill.

Limestone and dolomite, chiefly for road use, were produced by George Wendtlandt, Leo H. Klein, Huggins & Son, and Otto Jean.

Langlade.—Sand and gravel for highway and building use was produced by Duffek Sand & Gravel, Inc., and the Langlade County Highway Department.

Lincoln.—Merrill Gravel & Construction Co., Clifford Gatterman, and the Lincoln County Highway Department produced sand and gravel for highway use.

Manitowoc.—Manitowoc Portland Cement Co. operated a cement plant using four 10-foot-diameter rotary kilns, ranging in length from 160 to 340 feet. The company produced types I and II portland cement. Clay was produced in the company's own pit, and limestone was shipped from Michigan. The primary market for cement was within Wisconsin. The cement was shipped mostly by truck in bulk.

Rockwell Lime Co. produced quicklime and hydrated lime, and sold crushed limestone and agricultural stone. Several producers crushed limestone in the county, including Valders Lime & Stone Co., Rockwell Lime Co., and the Manitowoc Highway Department.

Sand and gravel was produced, chiefly for road use, by several companies that included R. & J. Fricke Co., Fred Radandt Sons, Schroeder Bros. Sand & Gravel Co., August Ehnert & Son, Evenson Brothers, and Kasper Construction Co.

Marathon.—Most of the State's dimension granite was quarried in Marathon County. Producers included Anderson Bros. & Johnson Co., Cold Spring Granite Co., Lake Wausau Granitie Co., Prehn Granite Quarries, Inc., and Wisconsin Quarries, Inc. Some decomposed granite was produced for road use by Tony Schilling. Mosinee Paper Mill Co., Mosinee, manufactured lime for its own use. Minnesota Mining & Manufacturing Co. operated the Rib Mountain Quarry, producing quartzite that was shipped to St. Paul, Minn., chiefly for use in manufacturing abrasives. It also operated another quarry for the production of argillite, a quartzitic mineral, which was used in manufacturing roofing granules. Ellis Quarries, Stevens Point, operated a sandstone quarry to produce flagging and architectural stone. Sand and gravel, chiefly for highway use, was produced by Riverside Gravel Co., Heiser Ready Mix Co., Lotz Sand & Gravel Co., and others.

Marinette.—Central Commercial Co. quarried andesite for the production of natural and colored roofing granules about 10 miles east of Pembine. Sand and gravel for road or railroad ballast was produced by Mason Sand & Trucking and Soo Line Railroad Co.

Marquette.—Montello Granite Co. quarried granite for the manufacture of monuments. Edward Kraemer & Sons, Inc., crushed limestone for highway use. The Marquette County Highway Department produced sand and gravel.

Milwaukee.—Types I and II, general use and moderate heat, portland cement was produced by Marquette Cement Manufacturing Co. at a plant in Milwaukee. Major raw materials were shipped from other

States—limestone from Michigan and shale from Illinois. Other raw materials included sand and gypsum. The plant had one kiln 175 feet long and 15 feet in diameter. The kiln operated 290 days in 1961. The dry process was used. Most of the cement was delivered to the consumer by truck, in bulk. The company also produced prepared masonry cements. The greatest quantity was sold to ready-mixed concrete companies. Crushed limestone, primarily for road use, was produced by Consumers Co. of Chicago, Ill., and Franklin Stone Products, Inc., Hales Corners. Sand and gravel for highway construction was produced by Ray Anderson Sand & Gravel Co., Moritz Sand & Gravel, and Consumers Co.

Monroe.—Limestone for road and agricultural use was produced by Schendel Brothers, Schultz Quarry Co. and Edward Kraemer & Sons, Inc.

Oconto.—Sand and gravel was produced chiefly for highway and building construction.

Oneida.—Sand and gravel and crushed limestone were produced in the county, chiefly for highway use.

Outagamie.—Lime was produced by Thilmany Pulp & Paper Co., Kaukauna, for use in its own plant. Limestone and sand and gravel, chiefly for road construction, were also produced in the county. The leading producers included Landwehr, Inc.; Black Creek Limestone Co.; and M. R. K. Construction Co., Inc.

Ozaukee.—Sand and gravel was produced, chiefly for highway use. The leading producers were Richard Weber, Inc.; Cedarburg Sand & Gravel; the Ozaukee County Highway Department; and Rowe Sand & Gravel, Inc.

Pierce.—Maiden Rock Silica Sand Co. produced sand chiefly for use as blast sand or in the hydrofraction of oil wells. Sand and gravel and crushed limestone were also produced for building and highway use.

Polk.—Bryan Dresser Traprock, Inc., quarried basalt and crushed it for highway use and as railroad ballast. Agricultural limestone was produced by the Polk County Agricultural Agent. Sand and gravel, chiefly for road use, was produced by the Polk County Highway Department, Bohn Sand & Gravel Co., Horsmann Block & Tile Co., and Ray Pearson (Atlas Gravel & Concrete Products Co.).

Portage.—Dimension sandstone for flagging and construction purposes was quarried by Ellis Quarries, Inc. Caldwell's Dredging Co. produced a small tonnage of marl for agricultural use. Sand and gravel for highway use was produced by F. F. Mengel Co. and Wimme Sand & Gravel. The Portage County Highway Department also produced sand and gravel. Sand and gravel also was used for railroad ballast.

Racine.—Union Grove Drain Tile Co. produced clay for the manufacture of heavy clay products. Consumers Co., Chicago, Ill., quarried and crushed a large tonnage of limestone for riprap, metallurgical flux, highway use, and agricultural use. Among the leading sand and gravel producers, chiefly for road and building construction, were J. W. Peters & Sons; Jeffries Construction Co.; Hillside Sand Co., Inc.; and the Racine County Highway Department.

Rock.—Considerable crushed limestone and sand and gravel were produced, chiefly for highway use. Leading producers of sand and gravel included Chicago, Milwaukee, St. Paul & Pacific Railroad Co.; Janesville Sand & Gravel Co.; and Edgerton Sand & Gravel Co. Leading producers of limestone included P. W. Ryan Sons, Inc.; Little Limestone Co.; Footville Lime & Rock Co.; and the Rock County Highway Department.

St. Croix.—Dimension limestone, for flagging or riprap use, was produced by St. Croix Valley Stone Co., Inc., and Wilson Rock & Limestone Co. Crushed stone for highway use was produced by these companies, and by Leary Construction Co. and the St. Croix County Highway Department. Sand and gravel, chiefly for road use and building construction, was produced by the county highway department, Edward Kraemer & Sons, Inc.; Casey Gravel Works; and Leary Construction Co.

Sauk.—Baraboo Quartzite Co., Inc., quarried quartzite and manufactured grinding pebbles and tube-mill liners. Output in 1961 was slightly greater than in 1960. The largest operation in the county was that of Foley Bros., Inc., which quarried quartzite chiefly for use as railroad ballast. Sand and gravel for highway use was produced by W. R. Dubois & Sons, Inc.; Baraboo Concrete Products Co.; and Deppe Lumber Co. Limestone quarries were operated to produce crushed stone for highway and (or) agricultural use. The leading producers were Edward Kraemer & Sons, Inc.; Davis & Richardson; W. W. Deppe; and Craig Seaman. Quartzite was mined chiefly for refractory use by General Refractories Co. and Harbison-Walker Refractories Co. Some dimension sandstone was produced by Merton Schultz.

Trempealeau.—Limestone was produced by Neuheisel Lime Works and Clarence Weiss, chiefly for riprap, concrete, roadstone, and agricultural use.

Washington.—Sand and gravel for road construction and building use was the chief product of Washington County. The leading sand and gravel producers included Ozaukee Sand & Gravel Co., The Reiske Corp., Kleist Sand & Gravel Co., John B. Jacklin, and Northern Sand & Gravel Co. Both limestone and sand and gravel were produced by the Washington County Highway Department.

Waukesha.—Producers of dimension limestone included Carlson's Stone Co., Cawley Stone Quarry, Dudovick Lannon Stone Co., Frank & Lindquist Lannon Stone Co., Halquist Lannon Stone Co., Joecks Brothers Stone Co., Johnson & Sons, Kindler Brothers Stone Co., Lisbon Lannon Stone Corp., Midwest Lannon Stone Co., W. G. Perren Quarry, Quality Limestone Products, Inc., Sussex Lannon Stone Corp., Weather Rock Lannon Stone Qy., and West Side Stone Co. These operators produced much of the dimension limestone, which was used chiefly for veneer, from the ledge-type deposits prominent in the area. Crushed limestone and sand and gravel for highway use were produced by several companies. The fines from crushing limestone were sold for agricultural use. Some peat was produced by Demilco, Inc.

Waupaca.—Clay was produced by Hockers Brick Co. for manufacturing heavy clay products. Marl for agricultural use was produced by Caldwell's Dredging Co.; limestone for building and highway construction, by C. H. Peters; sand and gravel, by H. G. Dieck Sand and Gravel and C. H. Peters.

Waushara.—Lohrville Stone Co. produced dimension granite at Red Granite. It also produced some dimension sandstone and quartzite. Marl was produced by Gaylord Dehling for agricultural use. Sand and gravel for highway use was produced by Edward Kraemer & Sons, Inc.; Oscar Fritz; and C. C. Linck, Inc.

Winnebago.—Badger Highways Co., Inc., produced riprap from a limestone quarry. It also crushed limestone for highway use and for asphalt fill. Other producers of crushed limestone, primarily for highway use, were Consumers Company, Chicago, Ill.; and Courtney & Plummer, Inc. Sand and gravel for highway use was produced by Courtney & Plummer, Inc.; Friedrich, Lots & Below, Inc.; Schutz Sand & Gravel, Inc.; Edward Kraemer & Sons, Inc.; and F. B. Dubberstein & Sons, Inc.

Wood.—Ellis Quarries, Inc., produced dimension sandstone for construction and flagging uses. Klesmith Stone Co. and Tony Schmick also produced dimension sandstone.

The Mineral Industry of Wyoming

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wyoming.

By F. D. Everett[1]

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MINERAL PRODUCERS in Wyoming reported another good year. Total value of mineral production increased 6 percent, from $438.7 million to $467 million. Petroleum output, representing 76 percent of the value of mineral production, advanced to a new high of 142.6 million barrels. Mineral commodities, with

TABLE 1.—Mineral production in Wyoming[1]

Mineral	1960		1961	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate .... short tons, gross weight..	5	$2	2	$1
Clays[2] .... thousand short tons..	788	9,571	859	10,301
Coal (bituminous) .... do....	2,024	6,992	2,529	8,573
Copper (recoverable content of ores, etc.) .... short tons..	----------	----------	1	1
Gem stones	(3)	68	(3)	83
Gold (recoverable content of ores, etc.) .... troy ounces..	40	1	1	(4)
Gypsum .... thousand short tons..	13	46	(5)	(5)
Mica (sheet) .... pounds..	(5)	(5)	27	(4)
Natural gas .... million cubic feet..	181,610	21,793	194,674	24,334
Natural gas liquids:				
LP gases .... thousand gallons..	120,693	5,279	132,831	5,451
Natural gasoline .... do....	72,195	4,535	76,349	4,705
Petroleum (crude) .... thousand 42-gallon barrels..	133,910	336,114	[6] 142,589	[6] 356,473
Pumice .... thousand short tons..	33	30	20	20
Sand and gravel .... do....	5,928	5,356	6,669	5,356
Silver (recoverable content of ores, etc.) .... troy ounces..	4	(4)	7	(4)
Stone .... thousand short tons..	1,401	2,302	2,594	3,315
Uranium ore .... short tons..	1,357,225	27,387	1,521,064	28,218
Vermiculite .... do....	(5)	(5)	30	(4)
Value of items that cannot be disclosed: Cement, clays (fire clay (1961) and miscellaneous clay), iron ore, lime (1961), phosphate rock, sodium carbonate, sodium sulfate, vanadium, and values indicated by footnote 5	----------	[7] 19,780	----------	21,046
Total Wyoming[8]	----------	[7] 438,733	----------	466,983

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay (1961) and miscellaneous clay; included with "Value of items that cannot be disclosed."
[3] Weight not recorded.
[4] Less than $500.
[5] Figure withheld to avoid disclosing individual company confidential data.
[6] Preliminary figure.
[7] Revised figure.
[8] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime.

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[1] Mining engineer, Bureau of Mines, Salt Lake City, Utah.

an output valued at over $1 million each, were petroleum, uranium ore, natural gas, sodium carbonate, clays, natural gas liquids, coal, sand and gravel, iron ore, cement, and stone. Other mineral commodities produced were phosphate rock, vanadium, gypsum, sodium sulfate, gem stones, pumice, and minor quantities of beryllium ore, copper, gold, silver, and mica.

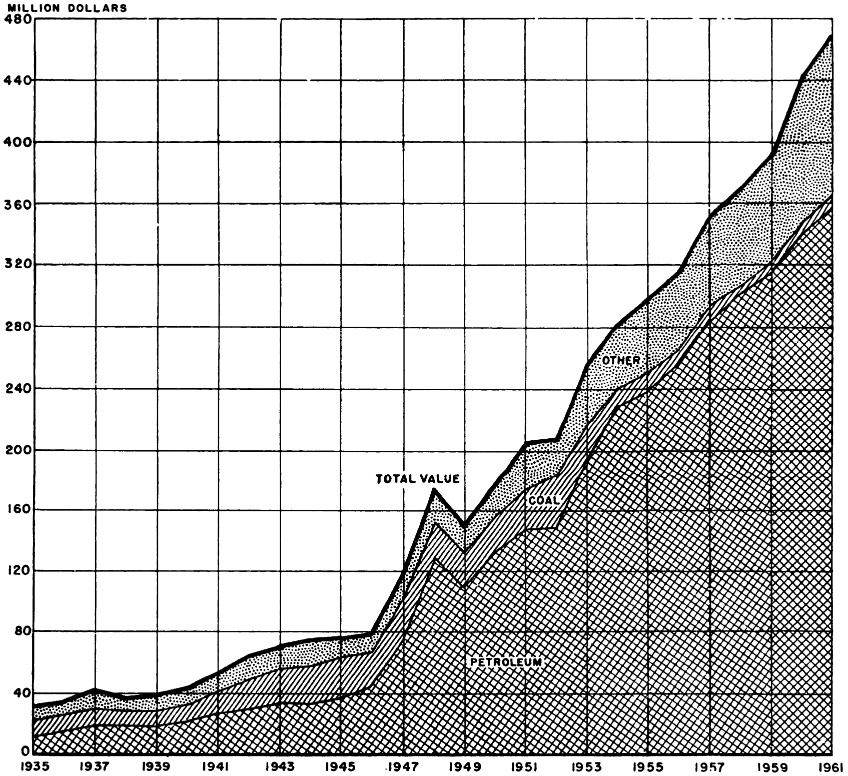

FIGURE 1.—Value of petroleum, coal, and other minerals, and total value of all minerals produced in Wyoming, 1935–61.

Increases were noted in the production of all commodities except beryl concentrate, cement, fire clay, gold, sheet mica, phosphate rock, pumice, sodium carbonate, sodium sulfate, and vermiculite. Mineral fuels contributed 86 percent, nonmetals 7 percent, and metals 7 percent of the total value of the production.

The Union Pacific Railroad Co. completed a new gas-extraction plant near Rock Springs and began processing 28 million cubic feet per day of natural gas. Benton Clay Co. added new facilities to modernize and increase the capacity of its bentonite plant at Casper. Big Horn Gypsum Co. began producing gypsum plasterboard in its new plant at Cody early in 1961.

First-stage construction of the Utah Power & Light Co. giant coal-burning generating plant near Kemmerer was about 10-percent complete at the end of the year. American Humates, Inc., began building a plant 2 miles east of Glenrock to make a humus-base, balanced fertilizer using the coallike mineral leonardite as the principal raw material; the plant was planned for completion about the middle of 1962. Stauffer Chemical Co. of Wyoming completed sinking service and production shafts and began plant construction at its soda ash project west of Green River. The Union Pacific Railroad Co. completed a 10-mile spur to the plant area. The plant was scheduled for completion in mid-1962. Progress continued at the Atlantic City iron project of the Columbia-Geneva Steel Division of United States Steel Corp., west of Lander, with completion expected about July 1962. Western Nuclear, Inc., began construction in October of a 400-ton-per-day upgrading plant for uranium ore from the Spook property, 43 miles northwest of Douglas. The plant was to have facilities for all the milling steps except filtering and drying, which were to be done at the company Split Rock mill at Jeffrey City. Petrotomics Co. began open-pit mining of uranium ore in the Shirley basin and began constructing the sixth uranium-ore processing mill in Wyoming. The mill was expected to be in operation about April 1962.

Pacific Power & Light Co. announced plans for constructing a third generating unit of 150,000 kw to supplement the two existing units of 100,000 kw each. The company also announced plans for building a chemical-process pilot plant near Glenrock that would utilize coal byproducts. Western Nuclear, Inc., reported plans to build a 100-ton-a-day plant to convert elemental sulfur into sulfuric acid, which would be used at uranium mills in Wyoming.

Employment and Injuries.—Final statistics of employment and injuries for 1960 and preliminary data for 1961 in the mineral industries, excluding the petroleum and natural gas industries, are given in table 2.

TABLE 2.—Employment and injuries in the mineral industries [1]

Industry	Number of operations	Average number of men employed	Total man-hours worked	Injuries		Frequency rate (injuries per million man-hours)
				Fatal	Nonfatal	
1960:						
Coal mines	25	566	628,836	1	12	20.7
Nonmetal mines and mills (other than sand and gravel and stone)	59	848	1,587,745	1	32	20.8
Sand and gravel plants	68	351	531,849	--------	9	16.9
Stone quarries and plants	31	326	601,171	--------	18	29.9
Ferrous and nonferrous mines and mills (excluding uranium)	13	330	450,372	1	20	46.6
Uranium mines and mills	110	1,415	2,861,610	6	121	44.4
Total	306	3,836	6,661,583	9	212	33.2
1961: [2]						
Coal mines	20	503	618,535	1	9	16.2
Nonmetal mines and mills (other than sand and gravel and stone)	66	866	1,689,044	--------	27	16.0
Sand and gravel plants	86	574	795,147	--------	5	6.3
Stone quarries and plants	39	442	827,287	--------	20	24.2
Ferrous and nonferrous mines and mills (excluding uranium)	13	415	569,518	--------	23	40.4
Uranium mines and mills	85	1,229	2,542,409	--------	99	38.9
Total	309	4,029	7,041,940	1	183	26.1

[1] Excludes petroleum.
[2] Preliminary figures.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels, representing 86 percent of the value of mineral production in the State, increased 7 percent—from $374.7 million in 1960 to $399.5 million in 1961.

Coal (Bituminous).—Coal was mined from 18 properties in 8 counties (properties with a production of less than 1,000 tons were not included). Output was 25 percent greater than in 1960. The increase resulted mainly from expansion of operations at the Dave Johnston mine in Converse County and the Rosebud mine in Carbon County. The largest production came from Converse County, followed in order by Campbell, Carbon, Sheridan, Lincoln, Sweetwater, Hot Springs, and Fremont. The five leading coal operations, all strip mines, were the Dave Johnston, Wyodak, Big Horn No. 1, Rosebud, and Elkol. The Dave Johnston mine, the State's largest operation, supplied the Pacific Power & Light Co. powerplant at Glenrock. The Superior D. O. Clark mine of Union Pacific Coal Co. at Superior was the largest producing underground coal operation. Rosebud Coal Sales Co. was developing a new strip mine near Hanna. The new operation featured automatically controlled coal-handling facilities and a drag line equipped with a 12-cubic-yard bucket on a 200-foot boom for stripping. The plant capacity was rated at 750 tons an hour. FMC Corp. and United States Steel Corp. continued to experiment and test products throughout the year in their joint venture in the production of metallurgical coke from noncoking coals near Kemmerer. Several trials had been made in substituting the processed product for coke in electrical furnace operations to make elemental phosphorous. Tests of the product were planned in iron and steel plants at Provo, Utah.

TABLE 3.—Coal (bituminous) production, by counties

(Excludes mines producing less than 1,000 short tons annually)

County	1960		1961	
	Short tons	Average value per ton [1]	Short tons	Average value per ton [1]
Campbell	458, 644	$1. 25	447, 447	$1. 29
Carbon	151, 676	3. 68	378, 593	2. 60
Converse	525, 998	3. 58	826, 422	3. 80
Fremont	1, 329	6. 17	1, 234	6. 17
Hot Springs	11, 820	9. 47	10, 488	9. 64
Lincoln	249, 605	3. 24	282, 159	3. 28
Sheridan	382, 377	3. 36	348, 828	3. 36
Sweetwater	242, 747	7. 27	233, 637	7. 13
Total	2, 024, 196	3. 45	2, 528, 808	3. 39

[1] Value received or charged for coal f.o.b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked, as estmated by producer at average prices that might have been received if such coal had been sold commercially.)

Natural Gas.—Natural gas production was 195 billion cubic feet, an increase of 7 percent over that of 1960. The natural gas came from 107 fields, as reported by 49 companies. Counties with natural gas production included Big Horn, Campbell, Carbon, Converse, Fremont, Hot Springs, Johnson, Lincoln, Natrona, Niobrara, Park, Sublette, Sweetwater, Uinta, Washakie, and Weston. Reserves reported[2] as of January 1, 1962, were 4,220 billion cubic feet, an increase of 7 percent over those on January 1, 1961. There were 95 natural gas well completions, 39 more than in 1960; 85 were development wells and 10 resulted in new discoveries. Well completion data for natural gas and petroleum are included in table 4. Natural gas processing began in a new plant of Union Pacific Railroad Co. near Rock Springs at the rate of 28 million cubic feet a day; gas was supplied from wells in Patrick Draw and West Desert Springs fields in Sweetwater County. N. C. Ginther completed a 5-million-cubic-foot-per-day natural gas processing plant in the Lonetree Creek field in Weston County and a 2-million-cubic-foot-per-day plant in the Rozet field in Campbell County. Gas Processors, Inc., operated portable natural gas plants, processing 4.5 million cubic feet per day in the Rozet field in Campbell County and in the Patrick Draw field in Sweetwater County; another portable 1.7-million-cubic-foot-per-day plant owned by this company was readied for Grass Creek field in Hot Springs County. Tower Oil & Gas Co. built a plant with a 7.5-million-cubic-foot-per-day capacity for operation in 1962 at Shawnee field in Converse County. In Park County, Pan American Petroleum Corp. expanded the capacity of its Elk Basin plant from 12 to 18 million cubic feet of gas per day. The proposed application for a pipeline from Rock Springs to Provo, Utah, where a connection was to be made with a line to California, had received conditional approval by the Federal Power Commission in 1960, but, because of changes in the application, the project was postponed to await additional hearings by the Commission.

Natural Gas Liquids.—Natural gas processing plants in 13 counties recovered 209.2 million gallons of natural gasoline, butane, and propane. Natural gasoline production was 76.3 million gallons, an increase of 6 percent, and butane and propane output was 132.8 million gallons, an increase of 10 percent over that of 1960. Gas Processors, Inc., operated new portable natural gas liquid plants in the Patrick Draw and Rozet fields, and it was building another plant for the Grass Creek field. Six trucks were required to move the largest plant from California to the Wyoming field.

Petroleum.—Crude petroleum production was 6 percent greater than in 1960 and came from 223 fields in 20 of the State's 23 counties. Thirty-four fields each had an output that exceeded 1 million barrels for the year, and 98 fields each had production exceeding 100,000 barrels. The number of wells drilled declined from 1,075 in 1960 to 995, a 7-percent decrease. Wildcat drilling of 391 wells yielded 18 oil, 4 condensate, and 10 gas discoveries for a success ratio of 8.2 percent. Development drilling of 604 wells resulted in 359 oil, 1 condensate, and 85 gas producers for a success ratio of 73.7 percent.

Three-fourths of the exploration wells drilled were in the Powder River and Green River basins. Discoveries were made in the four major basins—Powder River, 16 oil; Green River, 1 oil, 8 gas; Wind River, 2 gas; and Big Horn, 1 oil. The six largest producing fields were Elk Basin, Park County, 19 million barrels; Hamilton Dome, Hot Springs County, 9 million barrels; Patrick Draw, Sweetwater County,

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[2] Oil and Gas Journal, v. 60, No. 5, Jan. 29, 1962, pp. 124–125.

TABLE 4.—Wildcat- and development-well completions in 1961, by counties

County	Crude	Gas	Dry	Service	Total	Footage
Wildcat:						
Albany	---	---	3	---	3	9,100
Big Horn	---	---	7	---	7	25,400
Campbell	7	---	53	---	60	438,200
Carbon	---	---	17	---	17	82,600
Converse	[1] 1	---	5	---	6	25,100
Crook	6	---	57	---	63	294,600
Fremont	[2] 2	2	24	---	28	177,600
Hot Springs	---	---	4	---	4	11,000
Johnson	---	---	18	---	18	72,600
Laramie	---	---	1	---	1	7,600
Lincoln	---	---	2	---	2	8,200
Natrona	---	---	34	---	34	156,800
Niobrara	1	---	10	---	11	59,200
Park	1	---	10	---	11	61,100
Platte	---	---	1	---	1	7,500
Sheridan	---	---	4	---	4	23,500
Sublette	1	2	10	---	13	78,500
Sweetwater	[1] 1	6	37	---	44	302,100
Uinta	---	---	4	---	4	41,200
Washakie	---	---	5	---	5	14,900
Weston	2	---	53	---	55	226,600
Total	[3] 22	10	359	---	391	2,123,400
Development:						
Albany	---	---	1	---	1	4,500
Big Horn	9	---	6	---	15	57,600
Campbell	50	---	19	---	69	531,900
Carbon	1	2	3	---	6	17,700
Converse	5	---	3	6	14	76,300
Crook	30	---	20	1	51	275,500
Fremont	18	---	9	1	28	121,100
Hot Springs	14	---	1	---	15	50,100
Johnson	19	---	9	1	29	105,300
Lincoln	---	13	1	---	14	119,900
Natrona	64	---	15	---	79	114,600
Niobrara	1	---	2	---	3	12,900
Park	21	2	9	---	32	157,000
Sublette	32	57	9	1	99	427,800
Sweetwater	[1] 57	10	9	---	76	382,100
Washakie	2	---	3	---	5	16,900
Weston	37	1	28	2	68	314,200
Total	[1] 360	85	147	12	604	2,785,400
Total all drilling	[4] 382	95	506	12	995	4,908,800

[1] Includes one condensate-well completion.
[2] Includes two condensate-well completions.
[3] Includes four condensate-well completions.
[4] Includes five condensate-well completions.

Source: Oil and Gas Journal.

8 million barrels; Salt Creek, Natrona County, 6 million barrels; Oregon Basin, Park County, 6 million barrels; and Garland, Big Horn County, 5 million barrels. Six counties had an annual production in excess of 10 million barrels. They were Park, Hot Springs, Fremont, Natrona, Sweetwater, and Big Horn. Much of the Wyoming oil was produced by secondary recovery methods. A preliminary review indicated that 65 waterflood projects were conducted by 26 operators in 45 fields; most were in the Powder River basin.

The Oil and Gas Conservation Commission authorized the following secondary recovery projects: (1) Pan American Petroleum Corp. for a full-scale waterflood and gas injection program in the Phosphoria reservoir in Cottonwood Creek field, Washakie County; (2) Pan American Petroleum Corp. for a gas injection project for the Tensleep formation in Little Buffalo Basin field, Park and Hot Springs Counties; (3) Tenneco Oil Co. for waterflooding of the lower Muddy sand

TABLE 5.—Crude petroleum production, by counties

(Thousand barrels)

County	1960	1961[1]	Principal fields in 1961 in order of production
Albany	404	367	Quealy.
Big Horn	11,335	11,171	Garland, Byron, Bonanza.
Campbell	1,794	2,977	Rozet, Dead Horse Creek, Barber Creek.
Carbon	3,923	3,458	Wertz, Rock River, Big Medicine Bow.
Converse	4,637	4,284	Glenrock, Big Muddy.
Crook	4,620	5,083	Coyote Creek, Donkey Creek, Robinson Ranch.
Fremont	14,428	13,831	Beaver Creek, Steamboat Butte, Winkleman Dome, Big Sand Draw.
Goshen	17	25	Torrington.
Hot Springs	20,931	21,105	Hamilton Dome, Grass Creek, Murphy Dome, Little Buffalo Basin, Gebo.
Johnson	8,019	7,227	Sussex, North Fork, Meadow Creek.
Laramie	307	288	Horse Creek.
Natrona	12,127	12,604	Salt Creek, Grieve Unit, Salt Creek-E.
Niobrara	1,236	1,191	Lance Creek, Lance Creek-E, Little Buck Creek.
Park	33,283	34,086	Elk Basin, Oregon Basin, Fourbear, Frannie.
Sheridan	985	824	Ash Creek.
Sublette	1,588	1,764	Big Piney, La Barge.
Sweetwater	6,573	11,205	Patrick Draw, Lost Soldier.
Uinta	92	322	Spring Valley, Church Buttes.
Washakie	3,167	2,907	Cottonwood Creek, Worland, Slick Creek, Hidden Dome.
Weston	4,444	7,870	Raven Creek, Fiddler Creek, Kummerfeld, Miller Creek.
Total	133,910	142,589	

[1] Preliminary figures.

of South Glenrock field, Converse County; (4) Continental Oil Co. for a waterflood project for upper Muddy and Dakota sands in Block B of South Glenrock field, Converse County; (5) Continental Oil Co. for waterflooding in a field in Niobrara County; and (6) Kirby Petroleum Corp. for waterflooding in the Black Thunder (Clareton) field in Weston County.

Service Pipeline Co. built a 60-mile, 8-inch pipeline from the Big Piney field to Granger. Teton Pipeline Corp. completed the crude oil line from Dead Horse Creek–Barber Creek to Sussex in June. The Public Service Commission of Wyoming authorized Belle Fourche Pipeline Co. to build an oil gathering and transmission system of pipelines linking Prairie Creek field with the Miller Creek pumping station in the northeastern part of the State.

Refinery output was 42.6 million barrels, an increase of 10 percent over that of 1960. The nine refineries, in order of the quantity of oil processed, were Sinclair Refining Co., Sinclair; Texaco Inc., Casper; American Oil Co., Casper; Frontier Refining Co., Cheyenne; Mobil Oil Co. Division, Socony Mobil Oil Co., Inc., Casper; Empire State Oil Co., Thermopolis; Husky Oil Co., Cody; Sioux Oil Co., Newcastle; and C & H Refinery, Lusk. A new crude oil distillation unit built at the American Oil Co. refinery at Casper had a capacity of 37,000 barrels a day. Texaco Inc. added a new hydrogenation unit to its refinery at Casper for purifying various refinery products.

The Federal Bureau of Mines at its Laramie Petroleum Research Center conducted research on secondary recovery of petroleum, petroleum processing and utilization, and shale oil. Specific studies were made of physical properties, capillary behavior, and clay-mineral content of reservoir rock; characteristics of crude oils, and of sulfur compounds and nitrogen constituents in petroleum; purification of organic derivatives of the lighter elements; and characteristics of oil shale and its conversion to petroleum products. Reports on petroleum and oil-shale research were published.[3]

In 1961 the Supreme Court of Wyoming ruled that operators could deduct from crude oil prices some of the trucking charges for transporting oil to pipelines or railroad loading terminals. This ruling caused a general drop in the reported value of crude petroleum produced in the State.

NONMETALS

The value of nonmetal production increased 2 percent, from $33.8 million in 1960 to $34.6 million in 1961.

Cement.—The quantity of cement manufactured declined 6 percent. Monolith Portland Midwest Co. continued to be the only cement producing company. Cement rock, limestone, gypsum, sandstone, and coal were mined by the company within a few miles of Laramie and used in the manufacturing process. The cement was marketed chiefly in Wyoming and southern California.

Clays.—The production of fire clay sold or used increased, whereas miscellaneous clay output decreased, compared with that of 1960. More bentonite was produced (859,000 tons valued at $10.3 million) than any other class of clay. Bentonite was mined from deposits in Big Horn, Crook, Natrona, and Weston Counties.[4] Bentonite was processed at 11 plants operated by 8 companies and used chiefly in the oil-well drilling, foundry, and iron-agglomerating industries. In November, Benton Clay Co., Inc., began operating a new plant adjacent to its older plant in Casper. The new plant increased the processing capacity of the company plants.

Fire clay was produced from two properties—one in Big Horn County and one in Uinta County.

Miscellaneous clay production decreased 30,000 tons, compared with that of 1960. Lovell Clay Products Co. continued to manufacture brick and heavy clay pipe at Lovell; and The Idealite Co., formerly Great Western Aggregates, Inc., continued to process bloating shale into lightweight aggregate at Laramie.

A report on clay deposits of Wyoming was published.[5]

Gem Stones.—Gem stones found in Wyoming had a reported value of $83,000, $15,000 more than in 1960. Such semiprecious or ornamental stones as nephrite (Wyoming jade), agate, petrified wood, fossils, alabaster, and mineral specimens were collected by commercial dealers and individuals.

Gypsum.—Gypsum production in 1961 was greater than that in 1960. Two companies produced gypsum, one for use in the manufacture of cement and the other for manufacturing platerboard. About 1,000 tons of finely ground gypsum, mined in 1955, was sold for agricultural use. Big Horn Gypsum Co. completed construction of a plasterboard manufacturing plant at Cody and began operations early in the year.

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[3] Dinneen, G. U., R. A. Van Meter, J. R. Smith, C. W. Baily, G. L. Cook, C. S. Allbright, and John S. Ball. Composition of Shale-Oil Naptha. BuMines Bull. 593, 1961, 74 pp. Wenger, W. J., and B. W. Reid. Characteristics of Petroleum from the Powder River Basin, Wyo. BuMines Rept. of Inv. 5723, 1961, 123 pp.

Decora, A. W., and G. U. Dinneen. Gas Chromatography of Basic Nitrogen Compounds. BuMines Rept. of Inv. 5768, 1961, 23 pp.

Smith, J. W. Ultimate Composition of Organic Material in Green River Oil Shale. BuMines Rept. of Inv. 5725, 1961, 16 pp.

[4] Knechtel, Maxwell M., and Sam H. Paterson. Bentonite Deposits of the Northern Black Hills District, Wyoming, Montana, and South Dakota. Geol. Survey Bull. 1082–M, 1962, pp. 893–1030.

[5] Van Sant, Joel N. Refractory-Clay Deposits of Wyoming. BuMines Rept. of Inv. 5652, 1961, 105 pp.

Lime.—Limestone was processed into quicklime at three beet-sugar refineries. The Great Western Sugar Co. operated a plant at Lovell, and Holly Sugar Co. operated plants at Torrington and Worland.

Mica.—A small quantity of hand-cobbed mica was produced from one mica deposit in Niobrara County.

Phosphate Rock.—Phosphate rock production decreased for the second successive year. San Francisco Chemical Co., the only producer in the State, upgraded phosphate rock from Utah and Wyoming in a plant at Sage in Lincoln County. The processed rock was marketed chiefly in Utah for the manufacture of fertilizer and phosphoric acid.

Pumice.—Tongue River Stone Co. mined scoria from a deposit in Sheridan County. Output decreased 13,000 tons compared with that of 1960. The scoria was crushed and sized for use as railroad ballast and road gravel.

Sand and Gravel.—Output of sand and gravel increased 12 percent compared with that of 1960. Producers reported 37 commercial operations in 17 counties and 33 Government-and-contractor operations in 15 counties. Eighty-three percent of all sand and gravel produced was washed, crushed, screened, or otherwise prepared. Distribution of the total production was for paving, 88 percent; building, 8 percent; railroad ballast, 2 percent; fill, less than 1 percent; and miscellaneous, 1 percent. Producers in Natrona and Fremont Counties reported the largest output. Gilpatrick Construction Co., Inc., Woodward Construction Co., and D. W. Hopkins were the largest producers of commercial sand and gravel.

The Federal Bureau of Public Roads[6] indicated that for the year ended December 31, 1961, 41.8 miles of road was completed and 17.9 miles of road improved to acceptable standards. On the basis of 179.1 miles of road open to traffic since the program started July 1, 1956, Wyoming ranked 25th. Roads under construction totaled 174 miles, and roads in engineering or right-of-way status totaled 81.7 miles. The total designated mileage for the State was 915.8 miles of which 481 miles remained to be completed. Forty-seven percent of the interstate road program in Wyoming was completed.

Sodium Carbonate and Sulfate.—Production of soda ash from trona by Intermountain Chemical Co. from an operation west of Green River was 2 percent less than in 1960. A strike in November and December closed the mine and processing plant. Intermountain Chemical continued a mine-and-mill expansion program intended to increase production to 700,000 tons of soda ash a year. Stauffer Chemical Co. of Wyoming completed service and production shafts and began constructing a plant to process about 200,000 tons of soda a year. A 10-mile spur of railroad was completed from the main line of the Union Pacific railroad to the property northwest of the city of Green River. Production at the project was scheduled for mid-1962.

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[6] Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1961. Press release BPR 62–4, Feb. 7, 1962.

TABLE 6.—Sand and gravel production in 1961, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Albany	164	$117	Park	103	$122
Big Horn	123	51	Platte	26	24
Campbell	101	33	Sheridan	114	137
Carbon	144	65	Sweetwater	17	25
Converse	17	8	Teton	6	6
Crook	124	62	Uinta	23	17
Fremont	836	1,023	Washakie	41	37
Goshen	14	14	Weston	149	60
Johnson	136	175	Yellowstone National Park	107	107
Laramie	36	45	Undistributed	3,355	2,017
Lincoln	94	193			
Natrona	939	1,018	Total	6,669	5,356

TABLE 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1960		1961	
	Quantity	Value	Quantity	Value
Commercial operations:				
Construction sand:				
Building	150	$211	116	$183
Paving	48	69	44	58
Railroad ballast	14	14	17	8
Fill	(1)	(2)	2	4
Other	(1)	(2)	9	5
Total sand	212	294	188	258
Construction gravel:				
Building	153	216	338	453
Paving	1,558	1,029	1,399	1,330
Railroad ballast	161	81	122	61
Fill	10	14	7	9
Other			3	2
Miscellaneous gravel	18	21	12	11
Total	1,900	1,361	1,881	1,866
Total sand and gravel	2,112	1,655	2,069	2,124
Government-and-contractor operations:				
Sand:				
Building	51	87	25	52
Paving	45	113	379	93
Total sand	96	200	404	145
Gravel:				
Building	114	230	80	151
Paving	3,549	3,231	4,051	2,896
Fill			10	10
Other	57	40	55	30
Total gravel	3,720	3,501	4,196	3,087
Total sand and gravel	3,816	3,701	4,600	3,232
All operations:				
Sand	308	494	592	403
Gravel	5,620	4,862	6,077	4,953
Grand total	5,928	5,356	6,669	5,356

[1] Less than 500 short tons.
[2] Less than $500.

Natural sodium sulfate production from saline lakes in Natrona and Carbon Counties declined 279 tons from that of 1960. This product was used mostly as an additive to stockfeed.

Stone.—Production of stone rose 85 percent in quantity and 44 percent in value in 1961. This increase was mainly in Government-and-contractor crushed stone for road construction. Distribution of the total stone production by class was miscellaneous crushed stone, 61 percent; crushed limestone, 31 percent; crushed granite, 7 percent; crushed sandstone, 1 percent; and dimension sandstone, less than 1 percent. Miscellaneous crushed stone was used for road construction; limestone was used for manufacturing cement, manufacturing lime for refining beet sugar, road construction, building-drain material, smelter flux, and mineral food; crushed granite was used for riprap and railroad ballast; crushed sandstone, for cement and roofing material; and dimension sandstone, in the construction of buildings.

TABLE 8.—Stone production in 1961, by counties

County	Short tons	Value
Albany	(1)	(1)
Big Horn	42	$3,200
Carbon	1,229	1,737
Converse	(1)	(1)
Goshen	410	3,900
Laramie	(1)	(1)
Natrona	(1)	(1)
Platte	(1)	(1)
Teton	3,810	$3,810
Yellowstone National Park	438	1,840
Undistributed	2,587,600	3,300,843
Total	2,593,529	3,315,330

[1] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Sulfur.—Sulfur shipments decreased 43 percent compared with those of 1960. This reduction resulted in part from the closing in late 1960 of the Jefferson Lake Sulphur Co. plant at Manderson. In 1961, five companies recovered sulfur from hydrogen sulfide-bearing natural gas. One operation was in Big Horn County; two operations were in Park County, and two, in Washakie County.

Susquehanna-Western, Inc., manufactured sulfuric acid at its uranium mill at Riverton. Western Nuclear, Inc., announced plans to construct a plant in 1962 to manufacture sulfuric acid for use in uranium ore processing.

Vermiculite.—A few tons of vermiculite was mined and exfoliated at Encampment. The exfoliated product was sold as a soil conditioner.

METALS

The value of metals production increased 9 percent, from $30.2 million in 1960 to $32.8 million in 1961.

Beryllium.—Hand-cobbed beryl production totaled 3,324 pounds, a decrease of 60 percent from that of 1960. Five deposits were worked by three operators. The beryl was sold to the Government purchase depot at Custer, S. Dak., and to Mineral Concentrates & Chemical Co., Inc. (Mincon), of Loveland, Colo.

Copper, Gold, and Silver.—Production of 1 ton of copper, 1 ounce of gold, and 7 ounces of silver was reported from a mine south of Encampment in Carbon County.

Iron Ore.—Iron ore production increased 44 percent compared with that of 1960 and came from operations of The Colorado Fuel and Iron Corp. (CF&I) at Sunrise and of Magnetite Products Corp. at Iron Mountain. Construction at the Atlantic City iron ore project of the Columbia-Geneva Steel Division of United States Steel Corp. continued on schedule. A 76-mile railroad to the project from the main line of the Union Pacific railroad was completed in August. The project when completed was to include open-pit mining of taconite iron ore, crushing-grinding-sizing, concentrating by magnetic separation, agglomerating the concentrate into pellets, and shipping the product to the company's iron and steel facilities at Provo, Utah.

The Union Pacific Railroad Co. employed Koppers Co., Inc., of Pittsburgh, Pa., to make a feasibility study of the Strategic-Udy process for the reduction and refining of iron-titanium-vanadium ores[7] occurring in the Laramie area.

Uranium.—Uranium mining and processing evolved into one of Wyoming's major industries. Uranium ore production was 12 percent greater than in 1960, although the value was only 3 percent greater. A total of 79 operators reported production, 32 in Fremont County and the others in Carbon, Converse, Campbell, Crook, Natrona, Big Horn, and Niobrara Counties. Five uranium ore processing plants were operated throughout the year. A sixth mill was under construction by Petrotomics Co. in the Shirley basin. Western Nuclear, Inc., began constructing an upgrading mill 43 miles northwest of Douglas in Converse County.

Vanadium.—Vanadium production increased substantially compared with that of 1960. All vanadium was recovered from Wyoming uranium ores that contained significant quantities of vanadium and that were processed at the Mines Development, Inc., mill at Edgemont, S. Dak.

TABLE 9.—Mine production of uranium ore, by counties[1]

County	1960				1961			
	Number of operations	Ore, short tons	U_3O_8 contained, pounds	Value[2] f.o.b. mine	Number of operations	Ore, short tons	U_3O_8 contained, pounds	Value[2] f.o.b. mine
Big Horn	3	286	1,369	$5,518	3	(3)	(3)	(3)
Campbell	20	8,653	36,027	133,044	8	2,188	14,631	$61,670
Carbon	8	27,397	248,134	1,104,925	13,	276,975	1,411,223	5,789,376
Converse	13	50,810	214,323	857,449	11	28,841	129,384	522,448
Crook	13	83,957	377,043	1,527,396	7	75,866	352,205	1,443,379
Fremont	39	990,371	5,231,292	21,651,096	32	1,036,605	4,969,086	19,928,297
Johnson	1	34	82	196	--------	--------	--------	--------
Natrona	8	195,640	631,694	2,106,747	4	98,714	208,029	447,462
Niobrara	1	77	216	604	1	(3)	(3)	(3)
Undistributed	--------	--------	--------	--------	--------	1,875	6,869	25,001
Total	106	1,357,225	6,740,180	27,386,975	79	1,521,064	7,091,427	28,217,633

[1] Based on data supplied to the Bureau of Mines by the AEC.
[2] F.o.b. mine value; base price, grade premiums, and exploration allowance.
[3] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."

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[7] Dow, V. T. Magnetite and Ilmenite Resources, Iron Mountain Area, Albany County, Wyo. BuMines Inf. Circ. 8037, 1961, 133 pp.

REVIEW BY COUNTIES

Albany.—Monolith Portland Midwest Co. operated a cement plant at Laramie, the only one in the State. The plant capacity was increased by 100,000 barrels of cement a year, as the result of a modernization program. Wyoming Construction Co. quarried limestone, gypsum, and sandstone for the cement operation. In its plant at Laramie, The Idealite Co., formerly Great Western Aggregates, Inc., continued to process shale into lightweight aggregate that was used in building construction and into pozzolan that was used for concrete admixture. Three sand and gravel producers reported 50 percent less total output than in 1960. Sandstone was quarried and shaped into blocks by DeWald Stone Works.

Petroleum production came from 36 wells in 4 fields; Quealy field had the largest output.

Magnetite Products Corp. mined iron ore west of Iron Mountain. The iron ore was crushed, finely ground, concentrated by magnetic separation, and shipped to Gulf Coast States. According to the principal specifications, the product was to have a specific gravity of 4.5 and 95 percent of it was to be under one-fourth inch in size. The product was used as aggregate in concrete used to coat underwater pipe for the petroleum industry. Usually 3 to 4 inches of iron-aggregate concrete was used as a shell to add weight to the pipe and to prevent corrosion.

Big Horn.—Petroleum production accounted for 90 percent of the value of mineral output. The county was ranked sixth in petroleum production. Output came from 17 fields. Garland was the leading field, with an output of 5.3 million barrels of crude oil from 135 wells; followed by Byron, 2.5 million barrels from 77 wells; and Bonanza, 2.1 million barrels from 51 wells. Gas Processors, Inc., recovered elemental sulfur at the Garland natural gas processing plant.

Clay sold or used was greater than in 1960. The county was second in bentonite output; Magnet Cove Barium Corp. was the largest producer in the State. Wyo-Ben Products Co. also mined bentonite and processed it at a plant north of Greybull. Lovell Clay Products Co. mined fire clay and miscellaneous clay near Lovell; building brick, heavy clay pipe, and tile products were manufactured in the company plant. Three commercial and one Government-and-contractor sand and gravel operations reported production. Holly Sugar Co. at Worland processed limestone into quicklime for use in beet-sugar refining. Blackburn & Walker and Farley & Gibler produced uranium ore from three operations in the northeastern part of the county.

Campbell.—In terms of value, petroleum and coal were the highest ranking commodities, supplying 92 and 7 percent of the value of the mineral output, respectively. Crude oil production was 66 percent greater than in 1960 and came from seven fields. Rozet field supplied 1.8 million barrels; Dead Horse Creek field, 814,300 barrels; and Barber Creek field, 333,700 barrels. Discovery wells included No. 1 Dead Horse in the new South Dead Horse Creek field drilled by Great Western Drilling Co. in sec. 11, T. 47 N., R. 75 W., initially pumping 45 barrels of oil a day from the Parkman zone between 7,257 and 7,271

TABLE 10.—Value of mineral production in Wyoming, by counties

County	1960	1961 [1]	Minerals produced in 1961 in order of value
Albany	[2] [3] $5,955,138	$5,876,464	Cement, petroleum, iron ore, stone, clays, sand and gravel, gypsum, gem stones.
Big Horn [4]	[2] [3] 31,028,857	30,881,515	Petroleum, clays, sand and gravel, lime, uranium ore, stone, gem stones.
Campbell [5]	[2] 5,211,030	[3] 8,113,584	Petroleum, coal, uranium ore, sand and gravel.
Carbon [6]	[2] 11,595,985	15,497,828	Petroleum, uranium ore, coal, sand and gravel, sodium sulfate, gem stones, stone, copper, vermiculite, gold, silver.
Converse [7]	[2] 14,380,969	14,426,167	Petroleum, coal, uranium ore, stone, sand and gravel.
Crook [8]	[2] 18,438,053	19,997,206	Petroleum, clays, uranium ore, sand and gravel.
Fremont [6]	[2] 58,568,209	55,571,802	Petroleum, uranium ore, sand and gravel, gem stones, coal, beryllium concentrate.
Goshen	57,882	225,570	Lime, petroleum, sand and gravel, stone, gem stones, beryllium concentrate.
Hot Springs [4]	[2] 52,659,402	52,863,145	Petroleum, coal.
Johnson [6]	[2] 20,294,973	18,242,700	Petroleum, sand and gravel.
Laramie	[2] 2,116,176	1,514,811	Stone, petroleum, sand and gravel.
Lincoln [6]	(9)	(9)	Coal, phosphate rock, sand and gravel, gem stones.
Natrona [6]	[2] 33,269,507	33,229,603	Petroleum, sand and gravel, uranium ore, clays, stone, sodium sulfate, gem stones.
Niobrara [6]	[2] 3,103,698	[8] 2,978,539	Petroleum, uranium ore, mica (sheet), beryllium concentrate.
Park [6]	[2] 83,734,000	85,491,249	Petroleum, gypsum, sand and gravel, gem stones.
Platte	3,046,115	3,938,004	Iron ore, stone, sand and gravel, gem stones.
Sheridan	[2] 3,924,622	3,388,672	Petroleum, coal, sand and gravel, pumice.
Sublette [4]	[2] 4,099,400	[3] 4,410,000	Petroleum.
Sweetwater [6]	[2] 30,289,043	41,118,038	Petroleum, sodium carbonate, coal, sand and gravel, gem stones.
Teton	88,640	10,910	Sand and gravel, stone, gem stones.
Uinta [6]	[2] 310,383	885,800	Petroleum, clays, sand and gravel.
Washakie [6]	[2] 7,972,200	7,486,608	Petroleum, lime, sand and gravel.
Weston [6]	[2] 12,620,734	21,230,045	Petroleum, clays, sand and gravel.
Yellowstone National Park.	123,762	109,240	Sand and gravel, stone.
Undistributed [10]	[2] 36,367,837	40,389,204	
Total [11]	[2] 438,733,000	466,983,000	

[1] Value of petroleum is preliminary.
[2] Revised figure. [3] Excludes natural gas liquids.
[4] Excludes natural gas. [5] Excludes natural gas and vanadium.
[6] Excludes natural gas and natural gas liquids.
[7] Excludes natural gas, natural gas liquids, and vanadium.
[8] Excludes vanadium.
[9] Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[10] Includes natural gas, natural gas liquids, vanadium, and some sand and gravel, stone, gem stones, and beryllium concentrate (1960) that cannot be assigned to specific counties and values indicated by footnote 10.
[11] Total adjusted to eliminate duplicating value of raw materials used in manufacturing cement and lime

feet; No. 1 Halverson in the new Halverson field drilled by W. C. Leone in sec. 9, T. 49 N., R. 69 W., initially pumping 200 barrels a day from the Dakota formation between 6,908 and 6,917 feet; No. 1 Miller in the new East Rozet field drilled by Stuarco Oil Co., Inc., Murfin Drilling Co., and Risco Oil Co. in sec 21, T. 50 N., R. 69 W., initially pumping 233 barrels a day from the Muddy zone between 6,501 and 6,508 feet; F-50-70-4-C1 in the new Ward Creek field drilled by Clark Oil & Refining Corp. in sec. 4, T. 50 N., R. 70 W., initially pumping 30 barrels a day from the Muddy zone at 7,251 and 7,258 feet: and No. 1 Government-Gentry in the Rocky Point field drilled by McCulloch Oil Exploration Co. of California in sec. 3, T. 56 N., R. 69 W., initially pumping 30 barrels a day from the Minnelusa zone between 5,382 and 5,386 feet and 5,395 and 5,396 feet. Fifty development wells were completed. N. C. Ginther installed and operated a portable natural gas liquid plant with a processing capacity of 2 million cubic feet of natural gas a day; production capacity was 10,000 gallons a day of propane, butane, and gasoline. Wyodak Resources Development Corp. mined subbituminous coal from the Wyodak mine 6 miles east of Gillette for the 36th year. The coal was from the Smith and Roland beds in the Fort Union formation and had been mined from thicknesses ranging between 40 and 102 feet and averaging about 75 feet. Coal was produced chiefly for Black Hills Power and Light Co.

Uranium ore production decreased from 8,653 tons in 1960 to 2,188 tons; the value of production was 54 percent less than that of 1960. Uranium ore was shipped from eight operations by Hamlin Exploration & Mining Co., Morse C. Gilbert, Rosenlund & Cleghorn, Peg Shatzer, Powder River Mines, Inc., Western Uranium Corp., Ted Wallace, and Geo. Resources Exploration, Inc. All of the uranium ore produced was milled by Mines Development, Inc., at Edgemont, S. Dak., and contained vanadium which was recovered as a byproduct. One Government-and-contractor sand and gravel operation reported production.

Carbon.—The distribution of principal commodities in terms of value was petroleum, 56 percent; uranium ore, 37 percent; and coal, 6 percent. Crude oil output, all from 13 fields, was 11 percent below that of 1960. Wertz was the largest producing field with an output of 2.2 million barrels of oil, followed by Rock River with 834,100 barrels. One oil and two gas development wells were completed. The Sinclair Refining Co. refinery at Sinclair had a throughput of 9.8 million barrels of crude oil, an increase of 6 percent compared with that of 1960. Ohio Oil Co. produced natural gas liquids from the McFadden natural gas processing plant near Rock River.

Uranium ore was mined in two principal areas—Shirley basin and Baggs area. In the Shirley basin, Utah Mining Corp. operated an underground mine and Petrotomics Co. operated an open pit. Trace Elements Corp., a unit of Union Carbide Nuclear Co., division of Union Carbide Corp.; Basin Engineering Co.; and Sigma Mining Co. mined and shipped uranium ore from the Poison basin in the Baggs area to a mill at Maybell, Colo.

Hanna Basin Construction & Coal Co., Monolith Portland Midwest Co., and Rosebud Coal Sales Co. operated strip mines near Hanna; Mike & Harry Thomas operated an underground mine near Savery. Coal from the Monolith mine was used in cement manufacture. Coal from the Hanna Basin and Rosebud mines was used in industrial plants. Rosebud Coal Sales Co. continued development, begun in 1960, of a new mine. Although significant production was reported, a much larger output was anticipated for 1962. The coal was used mainly for powerplant fuel.

Rawlins Redstone Development Co. began roofing stone production at a new operation. Sweetwater Chemical Co. produced only half as much sodium sulfate as in 1960. The sodium sulfate was harvested from brine at Bull Lake north of Rawlins. Golden Clover Corp. mined and exfoliated 30 tons of vermiculite near Encampment. One commercial and four Government-and-contractor sand and gravel operations reported production.

Converse.—Petroleum, coal, and uranium ore production supplied 74, 22, and 4 percent of the value of mineral output, respectively. Petroleum production, from eight fields, was 4.3 million barrels, 8 percent less than in 1960; Glenrock, with an output of 2.1 million barrels, and Big Muddy, with 1.8 million barrels, were the leading producing fields. The new Flat Top field discovery well, drilled by Tower Oil & Gas Co. of Texas in sec. 18, T. 33 N., R. 68 W., flowed 3 million cubic feet of gas and 96 barrels of condensate per day from the Teapot zone between 6,989 and 7,009 feet. Of 14 development wells drilled, 5 resulted in completions and 6 were service wells. Cabot Corp. operated a plant with a daily throughput of 3.4 million cubic feet of natural gas and produced propane, butane, and natural gasoline. Tower Oil & Gas Co. began constructing a plant at Shawnee with a designed capacity of 7.5 million cubic feet of natural gas a day.

Coal was produced at strip mines operated by Best Coal Co. (Antelope mine) and Pacific Power & Light Co. (Dave Johnston mine). Coal production increased from 526,000 tons in 1960 to 826,000 tons. Pacific Power & Light Co. announced plans for the construction of a chemical process plant and a third power-generating unit at Glenrock. Work at the chemical process plant was to include research on liquid and solid carbon products, especially electrode coke for making electrodes for smelting metals, particularly aluminum. American Humates, Inc., began construction of a reported $1 million chemical fertilizer plant, 2 miles east of Glenrock. The operation was to utilize deposits of leonardite (highly oxidized lignite or low-grade subbituminous coal rich in humic acid) 18 miles north of Glenrock near the Dave Johnston coal mine. The end product of the process was to be about 40-percent soluble granulated humic acid, mixed with nitrogen, phosphate, and potash. The chief market for the fertilizer was expected to be the horticultural industry.

The value of uranium ore produced decreased from $857,500 in 1960 to $522,500. Output was from 11 operations, of which the largest were Vernon A. Mrak, Robert W. Adams, and B. & H. Mines, Inc. Most of the mining was in the Dry Fork area, 40 to 45 miles northwest of Douglas. The Spook property in this area was acquired by Western Nuclear, Inc., in 1960. The company began planning for construction of a preconcentrating mill in February 1961. The final plans included a complete mill except for equipment for filtering and drying the uranium slurry, which was to be hauled in trucks to the Split Rock mill at Jeffrey City, also owned by Western Nuclear, Inc. Completion was scheduled for early in 1962. The property had a quota of 522,000 pounds of uranium concentrate or 110,000 pounds of concentrate a year through 1966. Vanadium was recovered as a byproduct of uranium ore shipped from deposits in the county to the Mines Development, Inc., mill in South Dakota.

Rounds Construction Co. produced crushed stone from the Bright quarry for highway surfacing. Production was reported from one commercial sand and gravel operation.

Crook.—Of the total value of mineral output in the county, the value of petroleum production accounted for 64 percent; bentonite, 29 percent; and uranium ore, 7 percent. Petroleum production increased from 4.6 million barrels in 1960 to 5.1 million barrels in 1961. Production was reported from 10 fields, of which the leaders were Coyote Creek with 2.4 million barrels of crude oil, Donkey Creek with 1.5 million barrels, and Robinson Ranch with 805,157 barrels. Six new discoveries were made as follows: No. 1 Robinson in the new South Robinson Ranch field completed by M.K.M. Oil Co. in sec. 4, T. 49 N., R. 67 W., with initial production of 418 barrels of oil a day from the Minnelusa producing zones between 6,178 and 6,188 feet and 6,196 and 6,200 feet; No. 4 Koch-Krause in an unnamed new field completed by True Oil Co. and others in sec. 21, T. 49 N., R. 68 W., with initial pumping of 13 barrels a day from the Muddy producing zone between 6,022 and 6,038 feet; No. 5 Koch-Krause in the Coyote Creek field new producing zone completed by True Oil Co. and others in sec. 28, T. 49 N., R. 68 W., pumping 31 barrels a day from the Groat producing zone between 3,652 and 3,678 feet; No. 1 Federal-Robinson in the new East Robinson Ranch field completed by Shell Oil Co. and Davis Oil Co. in sec. 22, T. 50 N., R. 67 W., pumping 503 barrels a day from the Minnelusa producing zones between 5,650 and 5,656 feet and 5,666 and 5,672 feet; No. 1 Raudsep in the new North Miller Creek field completed by Skelly Oil Co. in sec. 5, T. 51 N., R. 68 W., pumping 43 barrels a day from the Dakota producing zone at 6,012 feet; and No. 1 Fowler in the new Jewel field completed by Shell Oil Co. and Sam Gary in sec. 7, T. 54 N., R. 67 W., pumping 420 barrels a day from the Minnelusa producing zone between 6,033 and 6,035 feet. Of 51 development wells, 30 were successful completions and 1 was a service well.

Bentonite production was 15 percent greater than in 1960. Producers were American Colloid Co., Baroid Division of National Lead Co., International Minerals & Chemical Corp., Black Hills Bentonite Co., and Archer-Daniels-Midland Co. Mills were operated by Baroid and Archer-Daniels-Midland Co. at Colony.

Uranium ore production, from seven operations, was 10 percent less than in 1960. Homestake Mining Co. was the largest producer, followed by Balboa Mining & Development Co., Geo. Resources Exploration, Inc., H. H. Bowen, and Quad Uranium Co. Vanadium was recovered as a byproduct of uranium ore shipped from the county to a mill operated by Mines Development, Inc., in South Dakota. One commercial and one Government-and-contractor sand and gravel operation reported production.

Fremont.—Fremont County ranked second in total value of mineral production. Of the total value, petroleum comprised 62 percent; uranium ore, 36 percent; and sand and gravel, 2 percent. Petroleum production decreased from 14.4 million barrels in 1960 to 13.8 million barrels. Twenty-five fields were productive; Beaver Creek with an output of 3.1 million barrels of oil was the largest, followed by Steamboat Butte with 3 million barrels, Winkleman Dome with 2.7 million barrels, and Big Sand Draw with 1.6 million barrels. Two condensate and two natural gas discoveries were completed: No. 1 Frenchie Draw Unit in the new Frenchie Draw field was drilled by Humble Oil & Refining Co. in sec. 21, T. 37 N., R. 89 W. and flowed 5 million cubic feet of natural gas and 60 barrels of condensate a day from the Fort Union producing zone between 9,101 and 9,183 feet, 9,241 and 9,275 feet, and 9,831 and 9,891 feet; No. 1 Government well in the new Dinty Moore Reservoir field was drilled by Shell Oil Co. and others in sec. 3, T. 37 N., R. 92 W. and flowed 2.6 million cubic feet of natural gas and 48 barrels of condensate a day from the Fort Union producing zone between 9,138 and 9,144 feet; No. 1 Poison Creek Unit in the New Poison Creek field was drilled by Humble Oil & Refining Co. in sec. 32, T. 37 N., R. 93 W. and flowed 2.6 million cubic feet of natural gas a day from the Fort Union producing zone between 5,418 and 5,432 feet; and Howard Ranch Unit in the new Howard Ranch field was drilled by Shell Oil Co. in sec. 15, T. 39 N., R. 93 W. and flowed 2.2 million cubic feet of natural gas a day from the Lance producing zone between 8,318 and 8,330 feet, 8,404 and 8,414 feet, 8,470 and 8,485 feet, 8,542 and 8,554 feet, 8,594 and 8,610 feet, and 8,938 and 8,952 feet. Of 28 development wells drilled, 18 resulted in successful crude oil completions and 1 was a service well. Pan American Petroleum Corp. operated the Beaver Creek processing plant with an average daily throughput of 29 million cubic feet of natural gas; propane, butane, and natural gasoline were produced.

The county ranked first in uranium ore production. Thirty-two operations were conducted by 15 producers. Twenty-eight of the operations were in the Gas Hills area, three were in the Crooks Gap area, and one was in the Copper Mountain area. The operators, in order of output of uranium oxide, were Western Nuclear, Inc.; Lucky Mc Uranium Division, Utah Construction & Mining Co.; Federal-Radorock-Gas Hills Partners; Vitro Minerals Corp.; Green Mountain Uranium Corp.; Globe Mining Co. Division, Union Carbide Corp.; The Hidden Splendor Mining Co.; Continental Uranium Company of Wyoming Division, Continental Materials Corp.; Dale B. Levi; Western Uranium Corp.; F A B Minerals Mining, Inc.; Hilmer Cummings Mining Co.; P–C Mining Corp.; Malcolm J. Reeves; and Robert W. Adams. Green Mountain Uranium Corp. and Continental Uranium Co. produced uranium ore from underground mines, and Western Nuclear, Inc., operated an open-pit mine in the Crooks Gap area. Hilmer Cummings Mining Co. operated the underground Arrowhead mine at Copper Mountain. All of the Gas Hills mines were open-pit operations, although some underground cleanup work was done from the pit floors, usually limited to about 125 feet of drifting. Four mills were operated, namely, Lucky Mc mill of Utah Construction & Mining Co. in Gas Hills; Split Rock mill of Western Nuclear, Inc., at Jeffrey City; Federal-Radorock-Gas Hills Partners mill of Federal-Radorock-Gas Hills Partners in Gas Hills; and Riverton mill of Susquehanna-Western, Inc., at Riverton. Federal-Radorock-Gas Hills Partners improved processing methods at its mill and increased the daily capacity to about 700 tons of ore. Considerable uranium oxide concentrate was recovered at the Lucky Mc mill by heap leaching. This method consists of percolating spent dilute acid from the main milling operation down through low-grade ores stockpiled near the mill, gathering the uranium-bearing solutions, and recovering uranium in the mill circuit. The company heap-leached

51,800 tons of low-grade material in 1961. Continental Uranium Co. completed the Reserve shaft in Crooks Gap to 585 feet and installed an automatically controlled hoisting system.

Three commercial and 12 Government-and-contractor sand and gravel operations reported production. Eight miles of road was paved between Riverton and the Gas Hills area, bringing the total to 22 miles of hard-top surfacing for this road. Ben George operated an underground coal mine at Hudson. Gem stones found in the county had a value estimated at nearly $34,000; nephrite (Wyoming jade) was the most prominent gem stone hunted, followed by agate and agatized wood. A small quantity of hand-cobbed beryl was produced from three pegmatite deposits in the Copper Mountain area. Construction at the Atlantic City iron-ore project by Columbia-Geneva Steel proceeded on schedule, with operations scheduled to begin in mid-1962.

Goshen.—Petroleum production, all from the Torrington field, increased from 17,000 barrels of crude oil in 1960 to 25,000. Less than one-half ton of hand-cobbed beryl was produced. Gem stones, lime, sand and gravel, and volcanic tuff output supplied the remaining value of mineral production. Lime was processed from limestone by Holly Sugar Co. at Torrington for use in beet-sugar refining.

Hot Springs.—The value of mineral production was mainly from petroleum and coal operations. Petroleum production from Hot Springs County ranked second in the State and came from 16 fields. The leading producing field was Hamilton Dome with an output of 8.9 million barrels of oil, followed by Grass Creek with 4.6 million barrels, Murphy Dome with 2.5 million barrels, and Little Buffalo Basin with 2.2 million barrels. No new discoveries were reported, but 14 of 15 development wells resulted in successful completions. Empire State Oil Co. operated the oil refinery at Thermopolis with a throughput of 3 million barrels. Gas Processors, Inc., readied a portable natural gas processing plant with an average capacity of 1.7 million cubic feet of natural gas and 2,000 gallons of natural gasoline a day. Two underground coal mines, with combined production of 11,000 tons, were operated by Roncco Coal Co. and T–K Coal Co.

Johnson.—Petroleum and sand and gravel were produced. Crude oil was produced from 10 fields; Sussex field was the largest with an output of 3 million barrels of oil, followed by North Fork with 1.3 million barrels, and Meadow Creek with 940,000 barrels. Of 29 development wells drilled, 19 resulted in successful completions. Continental Oil Co. operated a natural gas processing plant at Linch; plant throughput averaged 16.3 million cubic feet of natural gas a day, and propane, butane, and natural gasoline were produced. Four sand and gravel operations reported production.

Laramie.—The mineral production distribution in order of value was crushed stone (limestone and granite), petroleum, and sand and gravel. The Great Western Sugar Co. produced limestone at its Horse Creek underground mine primarily for 13 sugar refineries in Wyoming and adjoining States. The limestone was processed into lime at the beet-sugar plants for use in refining sugar. The limestone was crushed and screened into two sizes, No. 1 rock, 3 by 6 inches, and No. 2 rock, 1⅞ by 3 inches. Oversize rock was sold for riprap and undersize for railroad ballast and construction material. The company also supplied Peter Kiewit Sons Co. with limestone, which was screened and crushed for road construction material. The Horse Creek mine had been worked since 1904. Mining was from two nearly vertical beds 20 feet thick and 200 feet apart, for a length of 20,000 feet. Diesel locomotives had been used successfully in the underground haulage for many years. The Union Pacific Railroad Co., under contract with Morrison-Knudsen Co., Inc., mined, crushed, and screened granite at Granite Mountain; the rock was used for railroad ballast, riprap, and road construction material. The combined output of sand and gravel from three producers in the county was 89 percent less than in 1960. No Government-and-contractor production of sand and gravel was reported.

Petroleum production decreased from 307,000 barrels in 1960 to 288,000 barrels. Output came from four fields; Horse Creek field had the largest production with 143,900 barrels of crude oil. No discovery or development completions were reported. Frontier Refining Co. operated a crude oil refinery at Cheyenne with a throughput of 6.3 million barrels, 6 percent less than that of 1960.

Lincoln.—Coal, phosphate rock, sand and gravel, and gem stones were the mineral commodities produced. Coal production increased from 249,600 tons in 1960 to 282,000 tons.

Powerplant construction by Utah Power & Light Co. near Kemmerer was ahead of schedule. Completion date for the first 150,000-kw unit was June 1963. Three units were planned; the plant was eventually to produce 500,000 kw of electricity. The cost of the plant was estimated at $90 million. Kemmerer Coal Co. was to supply coal to the plant by a conveyor belt more than 1 mile long. The FMC Corp. and United States Steel Corp. joint venture in pilot plant research for production of metallurgical coke was active throughout the year.

Phosphate rock production declined 29 percent compared with that of 1960. The decline was partly because of efforts of San Francisco Chemical Co. to develop phosphate rock deposits in other areas. The company processing plant at Sage successfully concentrated low-grade phosphate rock by flotation. One commercial and one Government-and-contractor sand and gravel operation were reported active. Gem stones, agate, petrified wood, and fossil fish, collected in the county, had an estimated value of $500.

El Paso Natural Gas Co. operated a processing plant at Opal with an average daily throughput of 229 million cubic feet of natural gas. Natural gas liquids—propane, butane, and natural gasoline—were recovered.

Natrona.—Petroleum accounted for 95 percent of the value of mineral production. Natrona County ranked fourth in crude oil output, which increased from 12.1 million barrels in 1960 to 12.6 million barrels. There were twenty-five producing fields; the largest were Salt Creek with 6.2 million barrels, Grieve Unit with 3.3 million barrels, and Salt Creek–E with 852,400 barrels. Of 79 development wells drilled, 64 resulted in successful crude oil completions. A natural gas discovery well in the New Schrader Flats field was completed by Ferguson & Bosworth in sec. 26, T. 31 N., R. 82 W. and flowed 6.2

million cubic feet a day from the Muddy producing zone between 2,478 and 2,486 feet. Petroleum refineries at Casper were operated by Texaco Inc. with a throughput of 8 million barrels, American Oil Co. with 6.9 million barrels, and Mobil Oil Co. with 3.7 million barrels. Pan American Petroleum Corp. operated a plant at Salt Creek field and processed an average throughput of 22 million cubic feet of natural gas a day. Propane, butane, and natural gasoline were recovered.

The value of uranium ore production decreased compared with that of 1960. Four properties were operated, three by Globe Mining Co. and one by Federal-Radorock-Gas Hills Partners. Globe Mining Co. operated the Globe uranium ore processing mill in the eastern Gas Hills area.

Benton Clay Co., Inc., mined bentonite from deposits in the Steel formation near Natrona and near Midwest. Bentonite processing began in November in the newly constructed addition to the company plant at Casper. The bentonite processed in this mill was produced in Natrona County. The product was equally distributed for three uses, chemical, foundry, and oil-well drilling. Sodium sulfate production from saline lake deposits near Natrona and Casper was 15 percent greater than in 1960. Crushed granite was quarried from one operation and used for riprap, concrete, and roadstone; miscellaneous stone was quarried from one operation and used for riprap. Three commercial and six Government-and-contractor sand and gravel operations reported production.

Niobrara.—Petroleum output accounted for almost the entire value of mineral production. Crude oil output decreased 4 percent; production was from 10 fields. The largest output came from the Lance Creek field with 796,300 barrels of oil, followed by Lance Creek—E with 213,000 barrels and Little Buck Creek with 84,900 barrels. Of 11 wildcat wells drilled, 1 resulted in a discovery. The No. 2 Government lease well completed by Ranger Oil Co. in sec. 13, T. 37 N., R. 63 W. pumped initially 300 barrels of oil a day from the Dakota producing zone between 4,815 and 4,865 feet. Of three development wells drilled, one resulted in a successful completion. C & H Refinery decreased production by 11 percent compared with that of 1960. The annual throughput was 18,600 barrels. Ohio Oil Co. operated a natural gas processing plant at Lance Creek field with an average daily throughput of 2.6 million cubic feet and produced about equal quantities of propane, butane, and natural gasoline.

J. T. Starnes mined a small quantity of uranium ore from the Silver Cliff property. Small quantities of beryl and mica were hand-cobbed from pegmatite deposits.

Park.—Petroleum production comprised the major part of the value of mineral output, and the county ranked first in value of total mineral output. Crude oil production increased from 33.3 million barrels in 1960 to 34.1 million barrels. Output came from 22 fields of which the largest producing fields were Elk Basin with 19 million barrels of oil, Oregon Basin with 5.9 million barrels, Fourbear with 3.4 million barrels, and Frannie with 2.5 million barrels. Of 11 wildcat wells drilled, 2 resulted in new pay discoveries; Unit No. 55–33 in Silver Tip field was completed by Texaco Inc. in sec. 33, T. 58 N., R. 100 W., and began pumping 130 barrels of oil a day from the Madison producing zone between 9,107 and 9,120 feet; Unit No. 189 in Elk Basin field was completed by Pan American Petroleum Corp. in sec. 19, T. 58 N., R. 99 W., and began pumping 500 barrels of oil a day from the Jefferson producing zone between 5,468 and 5,510 feet and 500 barrels of oil a day from a Big Horn zone between 5,744 and 5,941 feet. Of 32 development wells drilled, 21 resulted in successful crude oil completions and 2 in natural gas completions. Husky Oil Co. increased crude oil refining production by 39 percent, compared with that of 1960, with an annual throughput of 2.9 million barrels. Pan American Petroleum Corp. operated the Elk Basin field natural gas processing plant with an average daily throughput of 15 million cubic feet, producing propane, butane, and natural gasoline. Pan American Petroleum Corp. and Texaco Inc., formerly Texaco Seaboard, Inc., produced elemental sulfur as a byproduct from natural gas processing.

Big Horn Gypsum Co. began manufacturing plasterboard in February. Gypsum for the plant was mined by Taggart Construction Co. at a deposit 4 miles southwest of Cody. Gem stones collected, consisting of opal, agate, agatized wood, fossils, and obsidian, were estimated at a value of $1,420. Four commercial and two Government-and-contractor sand and gravel operations were reported active.

Platte.—The value of mineral output increased 29 percent. CF&I produced iron ore (hematite) from its mine at Sunrise and transported it to the company iron and steel plant at Pueblo, Colo. During the year, the seven-compartment shaft was deepened to 750 feet and the seventh level was being developed. The ore was mined by block caving.

Crushed stone production increased 17 percent. Guernsey Stone Co. quarried, crushed, and screened dolomite near Guernsey for use as railroad ballast for the Chicago, Burlington & Quincy Railroad; riprap and road surfacing material were also produced. W. C. Graves mined, crushed, and screened miscellaneous stone for terrazzo chips. Gem stone hunters collected stones having an estimated value of $1,300. One commercial and one Government-and-contractor sand and gravel operation were reported active.

Sheridan.—Mineral production consisted of petroleum (61 percent of the county value of mineral output), coal (slightly less than 35 percent), sand and gravel (4 percent), and pumice (less than 1 percent). Petroleum production decreased from 985,000 barrels in 1960 to 824,000 barrels; Ash Creek was the only active field.

Big Horn Coal Co. and Welch Coal Co. operated strip mines; output for the year declined 9 percent, compared with that of 1960.

Tongue River Stone Co. mined scoria near Ranchester, primarily for railroad ballast; output was about two-thirds that of 1960. Activity was reported at two commercial and one Government-and-contractor sand and gravel operations.

Sublette.—Petroleum was the only mineral commodity produced. Output came from seven fields and increased from 1.6 million barrels in 1960 to 1.8 million barrels. Principal producing fields were Big Piney with 1.1 million barrels of crude oil and La Barge with 380,907 barrels. Of 13 wildcat wells drilled, 1 oil and 2 natural gas discoveries were reported; No. 2 Long Island Unit in the new Long Island field was completed by Belco Petroleum Corp. in sec. 35, T. 29 N., R. 112 W., and initial pumping produced 28 barrels of oil a day from the Wasatch zone at depths of 4,258 to 4,267 feet and 4,277 to 4,283 feet; No. 1 Star Corral Unit in the new Star Corral field was completed by Belco Petroleum Corp. in sec. 16, T. 30 N., R. 113 W., and flowed 849,000 cubic feet of natural gas a day from the Wasatch zone at depths of 1,627, 1,926, 1,942, 2,039, and 2,214 feet. Of 99 development wells drilled, 32 resulted in successful crude oil completions and 57 in natural gas completions. California Oil Co. began constructing a natural gas processing plant in the Birch Creek field near Big Piney.

Sweetwater.—The value of mineral production increased 36 percent compared with that of 1960. Petroleum accounted for 68 percent of the total value. Petroleum production came from 14 fields and increased from 6.6 million barrels in 1960 to 11.2 million barrels; the leading producing fields were Patrick Draw, 7.6 million barrels, and Lost Soldier, 3.3 million barrels. The drilling of 44 wildcat wells resulted in 1 oil and 6 natural gas discoveries; the No. 1 George well in the new George Ranch field was completed by Stuarco Oil Co., Inc., in sec. 27, T. 45 N., R. 66 W., with initial pumping of 278 barrels of oil a day from the Dakota producing zone between 6,540 and 6,543 feet; No. 1 Verbrugge-Government discovery in an unnamed field was completed by Chandler & Simpson in sec. 2, T. 18 N., R. 100 W., with initial flow of 1.5 million cubic feet of natural gas and 6 barrels of condensate a day from the Almond producing zone between 2,361 and 2,371 feet; the No. 1–8 Federal well in a Patrick Draw field new pay zone was completed by Texas National Petroleum Co. in sec. 8, T. 19 N., R. 98 W., with initial flow of 8 million cubic feet of natural gas a day from the Fox Hills zone between 3,739 and 3,745 feet; the No. 1 Moxa Unit in the New Moxa field was completed by Texaco Inc. in sec. 22, T. 19 N., R. 112 W., with initial flow of 1.3 million cubic feet of natural gas a day from the Frontier zone between 11,416 and 11,456 feet; No. 1 Winegar-Government discovery in a new field was completed by Chandler & Simpson in sec. 12, T. 20 N., R. 100 W., with initial flow of 8.5 million cubic feet of natural gas a day from the Almond producing zone between 2,890 and 2,906 feet; and No. 1–10 Government discovery in a new unnamed field was completed by Stateswide Oil Corp. and others in sec. 10, T. 21 N., R. 99 W., with initial flow of 725,000 cubic feet of natural gas a day from the Lewis zone between 3,848 and 3,858 feet. Of 76 development wells, 56 resulted in crude oil, 1 in condensate, and 10 in natural gas completions. Sinclair Oil & Gas Co. operated a natural gas processing plant in Lost Soldier field at Baroil with an average daily throughput of 4 million cubic feet a day, and Union Pacific Railroad Co. operated a processing plant at Patrick Draw field with an average daily throughput of 20 million cubic feet of natural gas a day. Gas Processors, Inc., operated a portable natural gas processing plant at Patrick Draw.

Coal production decreased compared with that of 1960. Production was from underground operations by the Union Pacific Coal Co. (Rock Springs No. 8 and Superior D. O. Clark mines), Gunn-Quealy Coal Co. (Rainbow No. 7 mine), and Edwin L. Swanson Bros. (Van Dyke mine).

Soda ash production from trona by Intermountain Chemical Co. was slightly less than in 1960 because a strike closed the operation during November and December. An expansion program was continued at the mine and the processing plant. Stauffer Chemical Company of Wyoming completed sinking a 16-foot-diameter circular service shaft and a 20-foot-diameter production shaft at the Big Island mine, 21 miles northwest of Green River, and construction began on the processing plant. Production was scheduled for the middle of 1962. Diamond Alkali Co. and Allied Chemical Corp. continued investigations of trona deposits. Gem stones, including agate, agatized wood, jade, fossils, and other stones, had an estimated value of $20,700. Activity was reported at one commercial sand and gravel operation.

Teton.—Mineral production consisted of sand and gravel, limestone, and gem stones. Utah-Idaho Sugar Co. produced crushed limestone for lime used in beet-sugar refining. The sugar rock was shipped by railroad to a company refinery in Idaho. Production was reported from two Government-and-contractor sand and gravel operations. Gem stones collected, mainly petrified wood, had a value of $900.

Uinta.—Petroleum output accounted for the major part of the total mineral value, followed by miscellaneous clay and fire clay and sand and gravel.

Petroleum output increased from 92,000 barrels in 1960 to 322,000 barrels. Productive operations were reported in four fields; Spring Valley field had the largest output with 218,500 barrels of oil. Four dry wildcat wells were drilled. Mountain Fuel Supply Co. operated a natural gas processing plant in Church Buttes field near Lyman; the average daily throughput was 55 million cubic feet of natural gas.

Interstate Brick Co. and Gladding, McBean & Co. mined miscellaneous clay and fire clay about 8 miles north of the old coal mining town of Almy. The clays were transported to brick manufacturing plants near Salt Lake City, Utah. Production was reported from one commercial sand and gravel operation.

Washakie.—Petroleum was the principal mineral commodity; production decreased from 3.2 million barrels in 1960 to 2.9 million barrels and came from 12 fields. Fields with the largest output were Cottonwood Creek, 2.1 million barrels, Worland, 226,000 barrels, Slick Creek, 177,000 barrels, and Hidden Dome, 163,000 barrels. Five dry wildcat wells were drilled. Of five development wells, two resulted in successful crude oil completions. Pan American Petroleum Corp. operated the Cottonwood Creek field natural gas processing plant with an average daily throughput of 17 million cubic feet, producing natural gas liquids and elemental sulfur. Pure Oil Co. operated a natural gas processing plant with an average daily throughput of 50 million cubic feet of gas from Worland field, producing propane, butane, and natural gasoline. Texas Gulf Sulphur Co. processed the gas for the Pure Oil Co. and produced elemental sulfur.

Two commercial and one Government-and-contractor sand and gravel operations recorded outputs. Holly Sugar Co. processed limestone into quicklime for use in beet-sugar refining in a plant at Worland.

Weston.—The value of mineral production was 68 percent greater than in 1960, with petroleum accounting for the major part of the increase. Petroleum producers reported a production of 7.9 million barrels from 13 fields; Raven Creek field with 1.9 million barrels had the greatest output, followed by Fiddler Creek field with 1.7 million barrels, Kummerfeld field with 1.3 million barrels, and Miller Creek field with 1.2 million barrels. Fifty-five wildcat wells were drilled resulting in two crude oil completions. Of 68 development wells, 37 crude oil wells and 1 natural gas well were completed successfully. Sioux Oil Co. operated an oil refinery at Newcastle; the annual crude oil throughput was reported at 1.7 million barrels. N. C. Ginther operated a new natural gas processing plant in Lonetree Creek field near Newcastle, producing liquid petroleum products; the average daily throughput was 4 million cubic feet of gas.

Bentonite production declined 3 percent from that of 1960. Bentonite was mined and processed by three companies, Baroid Division of National Lead Co. at Osage, American Colloid Co. at Upton, and Archer-Daniels-Midland Co. at Upton. Sand and gravel production was reported from one commercial and four Government-and-contractor operations.

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